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ABSTRACT

This guide contains the following five sections: (1) Building a Sound Knowledge Base -- learning theories, societal implications of technology, multimedia and the World Wide Web (WWW), school restructuring, university teaching in the information age, distributed learning on the WWW, collaborative learning environments on the WWW, organizing and searching instructional material on the Internet, and students programming with multimedia tools; (2) Changing Mental Models -- operationalizing mental modes, and looking at computers as a language; (3) Teaching & Learning -- universal intellectual standards, the National Educational Technology Project (NETS), rubrics for the assessment of information literacy, evaluating web sites, virtual conferences, pedagogical resources on the Internet, reading lists on technology and pedagogy, collaborative projects on the Internet, instructional design tools on the Internet, WWW constructivist project design, WebQuests, using the Web for learning, authentic science investigations on the Web, Hands-On and Far-Out Physics, digital portfolios, and helping students assess their thinking; (4) Classroom and System Connections -- netcourses in virtual high schools, learning for the 21st century, and the information age school; and (5) Resources -- basic information on emerging technologies. (DLS)

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Facing the Challenge of Technology Integration

ED 425 701

Student Guide

A Portfolio of Processes

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Pat Burke Guild

Where Do the Learning Theories Overlap?

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Multiple intelligences, learning styles, and brain-based education are distinct fields of study but share similar outcomes in the practical environment of the classroom.

Let's visit three schools. As we walk from classroom to classroom in the first school, we see students working on a variety of projects. In one room, a mural is in process; in another, a group of learners is building a bridge with various materials. Throughout the school, we see student work. In the library, many students' completed projects are on display. Sometimes we observe learners working together, other times alone. Older students are often working with younger ones. With some work, students are following structured directions; other times, they seem to be creating as they go along.

In the second school, groups of students are working at various learning stations. Some are sitting quietly, listening to tapes or working on written materials; others are playing games; still others are doing experiments and recording responses. The complexity of the tasks varies by age of the students and the content they are studying. In one classroom, the students are involved in a class meeting to discuss plans for their work at the centers.

In the other school, the visual displays make it immediately clear what content each class is studying. One primary grade is learning about desert animals. In an intermediate grade, the students are studying the culture of China. In another class, students are working on measurement. From classroom to classroom, we note a variety of group structures. Some students are working with a partner, some in small groups, and others in a large group with a teacher or older student directing the activity. In many classrooms, music is playing. Artwork is displayed throughout the building.

Three schools and three pleasant learning environments—with many common features: In each school, we find students actively involved in their learning, teachers talking with learners and with one another to make decisions and solve problems, students learning in a variety of ways, multiple resources available, displays of students' artwork, curriculum related to interests of students, parent volunteers working with learners, and regular assessment of the students' work as an integral part of the learning. When we talk to parents, they tell us about their satisfaction with their children's academic successes and with the emotional support the students feel at each school.

What is the mission of each of these schools? What are the goals and the beliefs? What was the catalyst for their particular approaches to learning? In one school, the teachers have studied and worked together to apply the theory of multiple intelligences; in another school, teachers are applying theories of learning styles; and in the third school, the teachers apply theories of brain-based education. Can you tell which school is committed to which of these theories by the descriptions of the visits?

Areas of Overlap

If we visited each of the schools for a longer period of time and talked with the teachers in depth, we would hear both similarities and differences in their beliefs and practices. Multiple intelligences, learning styles, and brain-based education have particular theoretical constructs, research bases, and applications. These fields are distinct and separate from one another in some ways, but in the practical environment of the school classroom, which calls for the application of the theories, the outcomes look strikingly similar.

Educators who believe in the concepts of learning styles, brain-based education, and multiple intelligences bring an approach and attitude[1] to their teaching of focusing on how students learn and the unique qualities of each learner. Each of these theories offers a comprehensive approach to learning and teaching, not a one-shot program. Each can be a catalyst for positive student learning. Each forces us to examine our values about people, learning, and education to make the hundreds of daily decisions that put beliefs into practice. What are some of the commonalties of brain-based education, learning styles, and multiple intelligences? I propose six areas of overlap.

Each of the theories is learning and learner-centered. The learner is the most important focus of the educational system. In an appropriate way, students are the center of attention. Schools that are learner-centered focus their energies on helping all students to be successful learners. They weigh decisions about struc-

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ture, rituals, routines, class composition, curriculum content and materials, and assessments and evaluation for their effect on the learners. Conversations center on learning. Outcomes emanate from the learners' needs and interests. Curriculum is organic, not preset to be covered in a specific time. The learning process is the dominant focus.

The teacher is a reflective practitioner and decision maker. In order to appropriately apply learning styles, multiple intelligences, and brain-based education, teachers must understand the theories, continue to study them, reflect upon them, and make appropriate applications for their own students and their own situations. The principles of the theories are a rationale for decisions and a catalyst for continual examination of schooling practices. Teachers have frequent and challenging conversations about their work.

The student is also a reflective practitioner. Students talk about their own learning and are active in the planning and assessment of the learning process. They are engaged in exploring, experimenting, creating, applying, and evaluating their ways of learning, as well as interacting actively with the content and concepts they are studying.

The whole person is educated. Teachers pay attention to the cultural, physical, social, and emotional life of the learner as well as to his or her academic life. Each of the theories promotes personalization of education by connecting the student's total life to the learning in the classroom. Educators acknowledge developmental stages and consider them in instructional and curriculum decisions. Respect for every individual is paramount and is evident in the climate of the school, including its management and its discipline procedures. When a child has a learning problem, comprehensive knowledge about the student becomes the basis of a solution.

The curriculum has substance, depth, and quality. Basic skills are treated seriously and frequently learned in the context of appropriate applications. Schools spell out high and sometimes uniform standards for learning outcomes, but they consciously avoid standardization of curriculum and methodologies. Proponents of brain-based education, learning styles, and multiple intelligences convincingly demonstrate that accommodating the students' learning strengths and individual intelligences and attending to ways the brain absorbs and processes information result in more effective learning.

Each of the theories promotes personalization of education by connecting the student's life to the learning in the classroom.

Each of these theories promotes diversity. It is a core principle in each theory that individuals are unique and that this uniqueness has an effect on students' various ways of learning. Teachers and students celebrate and foster diversity.

Common Cautions

Each of these theories also offers similar cautions. None pretends to be the single panacea to educational dilemmas. Proponents of learning styles, multiple intelligences, and brain-based education acknowledge the importance of good, solid teaching skills. Those practicing these theories neither discard research nor the wisdom of the past. Rather, they integrate current promising practices into the applications of the theories.

Each theory also, while it presents specific terms, labels, and vocabulary, cautions against simplistic applications of those terms. The original researchers of the theories continue to explore and develop their ideas and they warn against trivial quick-fix practices in the name of the theory.

Finally, none of the original theories aims to be a cookbook approach to teaching. When a theory about how people learn turns into a standardized program, it is a contradiction in both philosophy and practice.

The bottom line is that learning is a complex process and students learn in various ways. The teacher who acknowledges and actively responds to these truths will facilitate learning success for more learners. The theorists and promoters of brain-based education, learning styles, and multiple intelligences can contribute to effective applications by pointing out the complimentary aspects of their work. The primary message should be the need for serious understanding of the learner and the learning process.

Currently, too many students are not learning successfully in our schools—for a whole variety of reasons. Application of the theories of multiple intelligences, learning styles, and brain-based education offers more students the opportunity to succeed by focusing attention directly on how they learn. This priority is long overdue in our schools. We would be wise to keep the common principles of the theories of multiple intelligences, learning styles, and brain-based education in mind and not let competitiveness and differences among vocabulary and specific applications threaten the positive impact for teachers and students. ■

[1]For a discussion of approach and attitude, see Pat Burke Guild and Stephen Garger, *Marching to Different Drummers* (Alexandria, Va.: ASCD, 1985).

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Technology Changes Intelligence:
Societal Implications and Soaring IQs

By Robert J. Sternberg

TECHNOLOGY IS CHANGING SOCIETY IN MANY WAYS—SOME QUITE UNEXPECTED. IT'S BEEN CREDITED WITH MUCH OF THE DRAMATIC RISE IN IQ SCORES OVER THE PAST 30 YEARS. BUT WHILE TECHNOLOGY'S EFFECTS ON HUMAN INTELLIGENCE MEASUREMENT MAY BE POSITIVE, THERE ARE SOME DISTRESSING AND POTENTIALLY NEGATIVE REPERCUSSIONS. ARE THERE INEVITABLE SOCIAL TRADEOFFS FOR HIGHER IQS?

With all the moaning and groaning we constantly hear about the way schools educate our children, we often lose sight of an important and startling fact: intelligence, as measured by so-called intelligence quotients, or IQs, has been increasing over the past 30 years, and the increases are large—about 20 points of IQ per generation for tests of fluid intelligence such as the Raven Progressive Matrices, which require flexible thinking with relatively abstract and novel kinds of problems.

This effect, first pointed out by James Flynn and sometimes called the "Flynn effect" in his honor, has been found in every country where it has been possible to compare IQs across successive generations. We know it's there. But what's behind it?

No one knows for sure, but I think we can make an educated guess, and a good guess is that a major factor behind the massive IQ gains is an important force that has penetrated all but the most remote regions of the globe—technology.

Technology changes society profoundly, but in ways to which we become so accustomed that we hardly notice them. First radio and now television have brought to children concepts and points of view to which they would not have been exposed at the turn of the century. These days we continue to get weak programming, but we also get more and more coverage of a kind that was not formerly available, such as all-day news channels, the Discovery Channel, and the History Channel.

My goal here is to discuss the effects technology may have on human intelligence, not just with levels of intelligence but also what intelligence is. I will discuss some stunningly positive effects but some distressingly negative effects as well.

The Blessings of Technology

Let's start with the positive effects, as illustrated by examples that highlight two of the kinds of academic skills we care most about in our kids: mathematical and writing skills.

1. Computational Devices

When I went to elementary and secondary school in the 1950s and 1960s, we did all our mathematical computations by hand, and only as high school seniors did we begin to use the now almost forgotten slide rule to help us in these computations. To succeed in mathematics a student had to be skilled in computation because no matter how strong he or she was in conceptual and problem-solving skills, a wrong computation could easily lead to wrong answers in problem solving, as on homework, a quiz, or a test.

Most schools are quite different today. My children were using calculators in elementary school; and as high school students, they regularly use powerful programmable calculators that not only compute but also plot mathematical functions. They can use these calculators for homework, for teacher-made tests, and even for high-stakes testing such as the SAT.

In several important senses, our children's informed use of calculators has increased their intelligence. First, the calculators have removed virtually all of the computational errors they once would have been likely to have made in their work. Just in terms of the answers they can produce, therefore, what was once a common source of error has been removed. Second, the use of calculators changes the way they think about mathematics—and for the better. In the past, they would have had to devote substantial mental resources to the adequate implementation of computational formulas. Much of the time they would have spent doing mathematics would therefore have been spent in fairly mindless computations. Today those computations—done by calculator—take only a fraction of a second. The mental resources they once would have placed into computation can now be spent more productively on important mathematical operations—figuring out what the problem is, visualizing how to represent the problem, formulating a strategy for solving the problem, and programming or performing the operations that will enable the calculator to compute answers. Third, the very act of using the calculator forces them to learning programming skills, which are important for developing computer-based skills as well as for developing the kind of logical thinking one needs to succeed in disciplines including but not limited to mathematics.

The availability of calculators has also changed what intelligence is. Since the beginning of the twentieth century, intelligence has been defined in terms of individual differences that are meaningful for school performance. Indeed, Alfred Binet and Theodore Simon, in creating the first intelligence tests, were asked to develop an instrument that would distinguish children who were truly deficient in academic potential from children who were merely behavior problems.

To the extent that we have greatly decreased the importance of computational skills as a meaningful source of individual dif-

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ferences in school performance, the nature of mathematical ability for school has changed. Conceptual and problem-solving abilities, focal both to mathematics and to intelligence, have now become more important to success in school mathematics. In other words, we have made school mathematics more like real mathematics and more like the kind of activity we want students to do to develop their intellectual abilities. Moreover, as children learn to use more powerful computational devices, such as full-fledged computers, in their mathematical work, their opportunities to develop their intellectual skills will only increase.

2. Word Processing

The changes we have produced both in levels and in the nature of abilities apply not only in the mathematical domain but in other domains as well. Consider the case of word processing in the domain of writing.

Not so long ago, when someone wanted to write a poem, a short story, an essay, or whatever, the options were to use a pen or to use a pencil. Then typewriters came along, offering people the opportunity to increase greatly the efficiency with which words could be processed. When I learned touch-typing, a whole new world opened up to me. I could produce documents much more efficiently and quickly, and, perhaps even more important, I no longer needed to worry about what effect my awful penmanship would have on my teachers' evaluations of my work. Penmanship has become a less important ability not because it is any less a source of individual differences, but because its importance to how students are evaluated in the school setting has decreased.

Typewriters were an improvement, but correcting errors with a typewriter eraser was a slow operation. Recognizing this, my ninth-grade typing teacher subtracted 10 words per minute for every error we made in our timed tests; and I made a lot of errors! Two technological developments came along—eraser paper and liquid eraser fluid—and the correcting of errors became more rapid, less painful, and less disruptive of the flow of thoughts during writing.

As typewriters improved, so did the efficacy with which students could write. Manual typewriters were gradually replaced by electric typewriters, and then electronic typewriters became available. But a much bigger shift occurred when typewriters gave way to word-processing programs on computers. Where are those Royal, Remington, and Smith-Corona typewriters today? Many of them can be found only in antique shops.

With computers, typing mistakes can be corrected with the push of a button. Whole passages can be deleted, transformed, or moved from one place in a document to another in a fraction of the time it once took. My own productivity has increased many times over as a result of my being able to use a computer-based word-processing program to do my writing, including the writing of this article.

With word processors, students and other people can devote more time to thinking about the quality of their writing and less to the low-level mechanics of getting the writing done. If they make a typing error, they can correct it in seconds, thereby holding onto their train of thought. If they decide that a sentence doesn't work, deleting it can be done in seconds rather than in the minutes it once took to make the erasures on a document. If they wish to move one or more paragraphs to improve the flow of their writing, they can do in seconds what once might easily have taken several hours to rewrite or retype a document. Word processors enable writers to concentrate on composition, on logic, and on being creative rather than on the low-level mechanics of producing a finished-looking document.

Notice that, once again, technology has both increased the intelligence of students and transformed it. Their products are, or at least should be, better. Individual differences in analytical and creative writing skills have become more important as individual differences in penmanship, typing speed, and erasure speed have become less important to teachers' evaluations of students' products.

Technology can enable people better to develop their intelligence—no question about it. And the two cases I've given are only a small sample of those that might be mentioned. Computer games can help develop children's rapid thinking as well as spatial and perceptual-motor skills. New software also enables students to learn about science and scientific research in ways that were never possible before. What a blessing!

The Challenges of Technology

But technology can also be a curse. Almost anything that can be used to good purposes can be twisted to bad ones, and technology is no exception. Two more cases illustrate the challenges we face in implementing the technology we have available.

3. Television

Children, not to mention adults, spend enormous—some would say monstrous—amounts of time watching television. What return are they getting for the time they are spending?

Along with a fair amount of good television, there is a much larger amount of trash. It's easy to blame the networks, but we need to remember that they produce programming in response to what their surveys show people watch. People say they want one thing but often respond to another, as many chain restaurants found when they introduced healthful, low-fat food, only to find that the demand to have such products available was in no way matched by the demand to consume them.

Typical noneducational television can help children acquire some concepts and some vocabulary, but only to the relatively low level allowed on most shows. Not only are many shows relatively mindless, but so is the kind of information processing required to understand them. Anyone who has ever appeared on shows quickly learns that even responses to interviews on supposedly educational programs need to be kept short, simple, and direct. Banal questions encourage banal answers. For the most part, television does not encourage the development of active, mindful, and critical thinking.

The problem is not inherent in the medium, as anyone who has watched educational shows can confirm. It is in the use of the medium. This use is dictated, in turn, by demand, which determines the dollars sponsors are willing to pay to advertise their products on the shows. If we want change, we need to be willing to pay for it, which means financial support for educational programming. But it also requires parents who insist that if their children are going to watch television, at least a fair share of it needs to be educational programming.

4. Weapons

We do not often associate weapons with education, but in the final days of the twentieth century we have little choice. Every year seems to bring both greater technological sophistication and, unfortunately, easier availability of weapons to schoolchildren. The problem is one we cannot afford to duck, because it has many effects on children's thinking and lives, some of them not so easily observable to middle-class adults.

First, children who are spending their time worrying about violence in school and on the way to school are not thinking about lessons. The psychologist Abraham Maslow was among the first to point out that human motivation tends to be hierarchically structured, so that we need to worry about safety and survival needs before we can worry about needs for cognitive growth. Children worried about self-protection cannot be expected to engage fully in the educational program of the school.

Second, research shows that children who watch aggressive and violent models end up behaving in kind. The models we provide on TV shows do not speak well for the values we wish to foster in our children.

Third, kids are killing kids with weapons. More and more children are dying at each others' hands. The waste to our pool of human resources is enormous, both in terms of the children who die and in terms of the children who, having killed, inevitably find their lives permanently altered for the worse. Is this what we want for our children?

Fourth, in many nations of the world, sophisticated but cheap weapons like land mines are leaving a generation of permanently maimed children who are and will be severely challenged in their ability to adapt to the world in which they must live. The time other children are able to spend learning school subjects is time these children have to spend, day after day, week after week, and year after year, learning to cope with their injuries.

Summing Up

Technology can be and, from all the evidence available, has been a highly constructive force in the development of intelligence in our children. It has made it possible for them to experience events and even virtual worlds that were never available to their parents when they were children. Technology is helping to raise levels of intelligence and even reshaping what intelligence is. Increasingly, the intelligence one needs for coping with the environment will involve complex, higher-order thinking skills rather than routine, lower-order skills. At the same time, technology is creating challenges that we have been much less than effective in solving, challenges such as those challenges posed by television and weapons in the school environment.

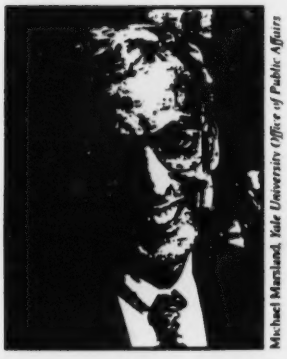
As technology increases the importance of higher-order thinking skills and decreases the importance of lower-order and more routinized ones, there is a risk of greater and greater socioeconomic polarization of our society. Those with good conceptual and technological skills will increasingly be able to advance to more meaningful and higher-paying jobs, whereas those without these skills will increasingly be relegated to lower-level jobs. Jobs that once were in the middle will start to creep upward or downward, or even disappear.

An effective secretary today, for example, must have the conceptual and technological skills to use sophisticated word-processing machinery effectively; the job has gone up scale. But to operate most cash registers, one needs only to be able to scan a bar code—no longer does one need to add, subtract, multiply, and divide; the job has gone downscale. And more and more middle-level jobs, such as those of telephone operator and bank teller, are dying out as technology does what was formerly done by humans. The middle is disappearing in the job market and in our socioeconomic stratification as well.

Sociologists speak of "Matthew effects," an expression coined by sociologist Robert Merton from the Biblical Book of Matthew based on the notion that to those who have much, more will come, and to those who have little, even less will come. Technology can create Matthew effects as it increasingly separates the skilled from the unskilled among both students and workers.

As a society, we need to be prepared for the changes to come. Most important, we need to educate all our students so that they do not get left out in the technological cold. We need to develop not only their technological skills but their conceptual ones as well. Those who have doubts only have to go through supermarket checkout lines, and watch the look of utter puzzlement that crosses the faces of some checkers when a product lacks the proper bar code.

Technology can bring a wonderful future to our children. But we have to shape it and teach children how to use it effectively and constructively. We need to remember that technology will not be a substitute for intelligence. It will change levels of intelligence and even what intelligence is. As educators, we need to ensure that the changes are for the better and not for the worse. ◄



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The Multimedia Makeover of the World Wide Web

By Odvard Egil Dyrli

It sings! It dances! Multimedia is supercharging the Web and bringing dynamic teaching and learning opportunities to schools. Here's a look at how it works, who's doing it, and where you can learn more.

Imagine that at a moment's notice your students could watch the eruption of a live volcano, attend a new year's celebration in Bali, or listen to a news broadcast in French. Or perhaps they would choose to walk through a German castle, climb to the top of a Mayan temple, or swim with sea lions in the Galapagos. Wouldn't such power transform both teaching and learning in your classroom?

Advances in computer and telecommunications technology are making such hopeful scenarios available to today's educators. It is now possible to use the Web to make global telephone calls, look through online cameras situated all around the world, see and hear "real-time" concerts thousands of miles away, hold face-to-face conferences with far-flung participants, and explore virtual reality environments with others from different states and countries.

Faster Computers, Faster Connections

Complex multimedia applications require the processing of gigantic amounts of data; and up until recently, computers and telecommunications technology were simply not up to the task. Now, however, two technology trends are fueling the developments:

1. **Computer processing power at a given price doubles approximately every eighteen months.** So computer technology costing $200,000 today will in about seven years cost only $2,000, and the computer we buy at the same price then will be 100 times more powerful than the one we use today. Although you can still enjoy these newer developments without the latest powerhouse technology, they require multimedia systems with a minimum of 16 megabytes of RAM (32 megabytes or more is recommended), hard drives measured in gigabytes, and built-in microphones, speakers, sound and video cards.
2. **Telecommunications speeds are increasing dramatically.** Advances in modem, cabling, and wireless technologies make possible significant increases in transmission bandwidth, so the quality of online multimedia is less compromised by slow speeds. In addition, the cost of "direct connections"—such as T1 lines—continues to drop, and high-speed service is becoming available to growing numbers of schools.

Related to these developments are new options for getting online. These include set-top boxes that let you surf the Web from televisions, stripped-down "network computers," and hand-held devices built around Microsoft's Windows CE and Apple's Newton OS systems. As more people connect to the Web, the demand grows for sophisticated online experiences, a trend which will benefit education.

The Evolving Web

The World Wide Web was originally a "hypertext" medium where clicking

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on highlighted words on a Web page called up related text pages from anywhere in the world. When improvements in the technology allowed graphics to be displayed, the online experience was enhanced by color pictures, photographs and diagrams, yet pages were still largely "static." But soon faster telecommunications and processing speeds brought "hypermedia" to the Web, with animated displays that could talk, sing and dance. A page hot-spot might download and play an audio or video selection, or call up a related page with multimedia features.

Now, however, the technology has advanced to the point where highly interactive applications such as simulations, 3-D, and virtual reality environments are possible. Another development is so-called "streaming" technology: real-time audio and video that doesn't need to be downloaded—so that live events can be seen and heard as they happen. There is also significant growth in "push" technologies, where content is sent directly to users through online information channels (as opposed to the usual "pull" system where users seek and find the content they desire).

The technologies that underlie many of these developments include:

- **Java from Sun Microsystems** *(java.sun.com)*. Java is a programming language developed to deliver interactive animation and multimedia over the Web. Sun collaborated with Netscape (*www.netscape.com*) on JavaScript, a scripting language that lets non-programmers use Java tools. For examples, see the many Java applications on the Gamelan Web site (*www.gamelan.com*).
- **ActiveX Controls from Microsoft** *(www.microsoft.com)*. ActiveX is a "Java-like" technology that delivers interactive multimedia over the Web. For more information, see the ActiveX Web site *(www.activex.com)*.
- **Shockwave from Macromedia** *(www.macromedia.com)*. Shockwave allows users to view multimedia developed using Macromedia *Director* software at Shockwave-enhanced Web sites. See, for example, the applications on Shockzone *(www.macromedia.com/shockzone)*.
- **Virtual Reality Modeling Language (VRML) from Silicon Graphics** *(www.sgi.com)*. VRML is a set of standards developed by Silicon Graphics and Netscape for the creation of 3-D environments. However, other companies have competing virtual reality technologies, such as QuickTime VR from Apple *(quicktime.apple.com)*.

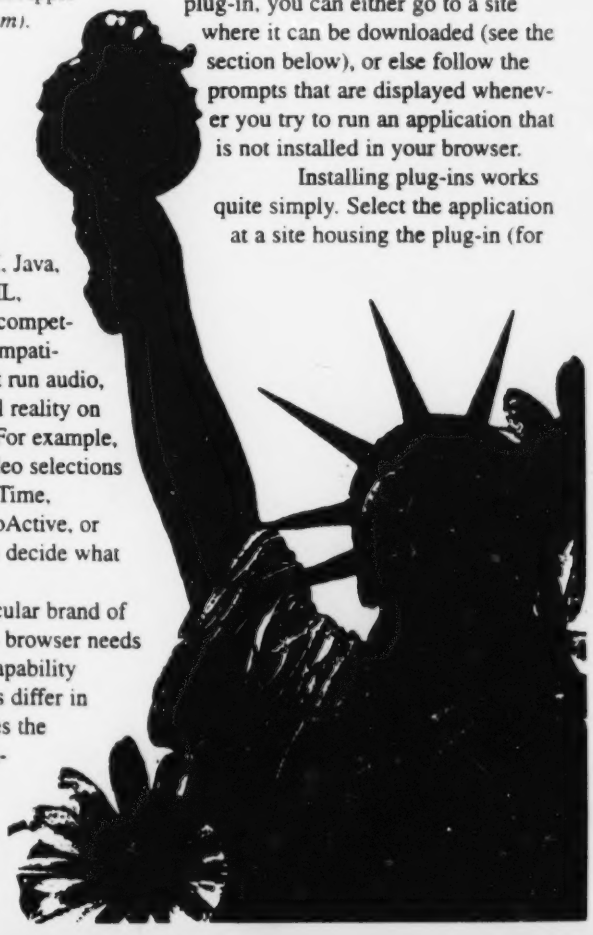
What You Need for Web-based Multimedia

In addition to ActiveX, Java, Shockwave, and VRML, there are hundreds of competing—and usually incompatible—technologies that run audio, video, 3-D, and virtual reality on the Web (see below). For example, many sites include video selections developed with QuickTime, RealVideo, VDO, VivoActive, or Vxtreme. How do you decide what you need?

In order to run a particular brand of multimedia, your Web browser needs to have that specific capability installed, and browsers differ in how well each executes the major types of applications. For example, Internet Explorer 3.0 does a better job with ActiveX technology, and Netscape 3.0 is more versatile with Java. In either case, the use of ActiveX and Java is seamless, since the browsers can launch the required application immediately. Similarly, each new browser version—versions 4.0 are now being released—usually includes either the more successful new technologies, or else incorporates features with similar capabilities.

But you may also want to add extra capabilities not included in your browser to run different kinds of multimedia. To do so, your system needs a special "player/viewer" program for each type of application. These specialized "plug-in" programs can be downloaded directly to your Web browser and executed whenever required. Plug-ins have been developed for all sorts of uses, and most are available for free. To get a certain plug-in, you can either go to a site where it can be downloaded (see the section below), or else follow the prompts that are displayed whenever you try to run an application that is not installed in your browser.

Installing plug-ins works quite simply. Select the application at a site housing the plug-in (for



The Web Goes Multimedia

example. "RealPlayer" (which plays RealAudio and RealVideo files) is available from the *www.real.com* Web site. Then, specify where you want the installation program placed on your machine (it's a good idea to write down the file name and location). After it is downloaded, click to execute that program, and it will install the plug-in automatically. From then on, you can use that type of application whenever you encounter it at a site.

Under the Hood: New Technologies

What follows are the major technologies bringing multimedia to the Web, organized by category. These listings also contain sources for plug-ins, demonstrations of each type of technology, links to sample applications, and information about how you can learn more.

Live Cameras

Let your students see a live scene from Norway, zoom a camera in Hawaii, or control a model railroad train in Germany. These sites link to cameras placed all over the world.

- **EarthCam** *(www.earthcam.com)*
- **Live NASA Cams** *(www.ambitweb.com/nasacams/nasacams.html)*
- **Tommy's List of Live Cams** *(www.rt66.com/~ozone/cam.htm)*
- **Web Voyeur** *(rainier.net/~larry/web-voyeur)*

Push Technologies

These push technology sites download information "channels" covering topics of your choosing—news, sports or weather, for example—directly to your computer, often in the form of a screen saver. Educast is of particular interest to educators, since it brings multiple channels of education-related information to your desktop.

- **AfterDark Online** *(www.afterdark.com)*, screen saver
- **BackWeb** *(www.backweb.com)*, channel provider
- **Educast** *(www.educast.com)*, screen saver
- **Marimba Castanet Tuner** *(www.marimba.com)*, channel provider
- **Netscape In-Box Direct** *(home.netscape.com)*, e-mailed Web pages
- **PointCast Network** *(www.pointcast.com)*, channel provider
- **Intermind Communicator** *(www.intermind.com)*, channel provider
- **My Yahoo! News Ticker** *(www.netcontrols.com)*, news crawl

Intelligent Agents

An intelligent agent scours the Web on your behalf, looking for information according to criteria that you specify. It then pushes the content it has discovered to your machine, whenever you return to its home site. For example, if you register at My Yahoo!, you can receive daily updates on top Internet stories, business reports, stock prices, news, weather, and sports.

- **Firefly** *(www.firefly.com)*
- **My Yahoo!** *(my.yahoo.com)*
- **WiseWire** *(www.wisewire.com)*

Chat Lines

Chat rooms have long been available on commercial online services. However, the selections below are Web-based and moderated. The first example is a place for young people to exchange information, while the others target adults. TalkCity includes separate chat lines on a variety of topics, schedules theme events—such as book discussions—and offers users a chance to chat in 3-D and VRML environments.

- **FreeZone ChatBox**—kids and teens—*(www.freezone.com)*
- **Ichat** *(www.ichat.com)*
- **TalkCity** *(www.talkcity.com)*

Bringing it Together

The following sites exemplify how multiple online multimedia technologies can enhance your experience at a single Web location.

- **ABC News** *(www.abcnews.com)*
- **Bonus.com,** the SuperSite for Kids *(bonus.com)*
- **C|Net** *(www.cnet.com)*
- **CNN Interactive** *(www.cnn.com)*
- **Discovery Channel Online** *(www.discovery.com)*
- **ESPN's SportsZone** *(www.espn.com)*
- **Headbone Zone** *(www.headbone.com)*
- **Humongous Entertainment** *(www.humongous.com)*

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(continued on page 28)

Sampling the Goods

The following sites, covering areas of interest to educators, demonstrate the power and potential of multimedia on the Web, arranged by increasing order of complexity. If your browser is unable to run an application directly, you will be prompted to install the needed plug-in.

Bigfoot *(www.bigfoot.com)*. This site for finding people anywhere in the United States includes interactive maps to people's homes (try it on your own name and address!). Buttons let you zoom in or out on a display to redraw the maps with different scales.

Timecast *(www.timecast.com)*. Timecast is an online guide to hundreds of audio, video, and live events on the Web. By checking the site's daily listings, your students can sit in on interviews, listen to concerts, and follow news broadcasts as they are happening.

VRML World *(www.eye.com/triwrld/studio/vrml.htm)*. This site includes unusual examples of 3-D, animation, and virtual reality technologies. Be sure to examine the virtual objects—such as a hammer, dart, and weather vane—that can be picked up, moved, and turned around in space.

Virtual Times Square *(www.hbo.com/vr)*. Home Box Office set up these 360-degree views of New York City's Times Square using QuickTime VR and VRML. You can take a 360-degree walk around the city streets, and zoom in and out on what you see.

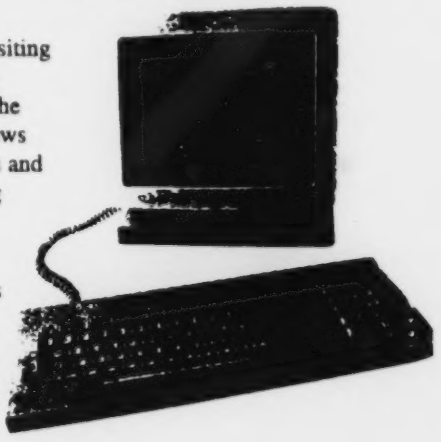
Expedia Full Circle *(207.68.149.20:80/daily/fullcircle/archives)*. This Microsoft-sponsored site—which works best with Internet Explorer—uses Surround Video technology to present 360-degree views of worldwide sites including the Grand Canyon and cities in France and Guatemala.

Cybertown *(www.cybertown.com)* Cybertown is a multi-user 3-D virtual reality environment set up as a futuristic city on another planet. Cybertown has many areas to explore, things to do, and people to meet from all over the world.

Great Cities of Europe *(www.tion.com/cineworld/index.html)*. This site offers multimedia tours of European cities—such as Munich, Germany, with its castles and museums—that include films, photographs, audio clips, and virtual reality elements.

Wandering Italy *(www.wandering.com)*. Using Real Space virtual reality technology, this site is essentially a multimedia unit on Italy. You can visit any of the cities highlighted on a map of the country through audio and video, and tour selected sites through 360-degree virtual reality.

Palenque: Lost City of the Maya *(www.talkcity.com/seismic/mainmenu.html)*. Visiting the Mayan ruins of Palenque requires a Java-enabled browser—and therefore works best with Netscape—as well as QuickTime, RealVR and RealAudio. The design combines many multimedia features effectively, such as panoramic views of the countryside; picking up, manipulating and learning about found objects and artifacts; interacting with other people anywhere in the world who are visiting Palenque at the same time; and exchanging messages with experts who are scheduled to be in the city at certain times.



The Earth and Moon Viewer *(www.fourmilab.ch/earthview/vplanet.html)*. This is an outstanding example of the complex multimedia experiences that are becoming possible online. The simulation allows you to "stand" on various bodies in the solar system and look back at the Earth and moon. For example, you can view the earth from scores of satellites, and see continents, polar ice caps, and even "sunrise" as the satellite circles the Earth.

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Phones on the Web

There are numerous competing technologies that use the Web to deliver phone service. All of the sites listed below offer free software downloads for evaluation and experimental purposes, but some sell more full-featured versions with better quality.

- **FreeTel** (www.freetel.com)
- **Intel Internet Video Phone** (connectedpc.com/iaweb/cpc/iivphone)
- **PhoneFree** (www.phonefree.com)
- **VocalTec Internet Phone** (www.vocaltec.com)
- **WebPhone** *(www.netspeak.com)*

Web Conferencing Software

CU-SeeMe, the pioneering free videoconferencing software developed at Cornell University, is now available commercially. It is a powerful way to connect students with peers around the world, cap off a cooperative project, or consult with a subject-matter expert. ICQ ("I seek you") is text-based communications software that also lets you know when people in your database are online—so you can have a real-time exchange—and Cooltalk and Netmeeting have the advantage of being available to all users of Netscape and Internet Explorer respectively.

- **CU-SeeMe** *(cuseeme.cornell.edu); (www.cuseeme.com)*
- **ICQ** *(www.mirabilis.com)*
- **Connectix Videophone** *(www.connectix.com)*
- **CoolTalk**–includes a phone, text chat tool and white board *(www.netscape.com)*
- **NetMeeting**–includes a phone, text chat tool and white board *(www.microsoft.com)*

Audio

Although audio features are incorporated in most Web browsers and in video technologies such RealVideo and VDO, RealAudio is far and away the dominant audio plug-in, and is widely used for broadcasts and live events.

- **RealAudio** *(www.real.com)*

Video

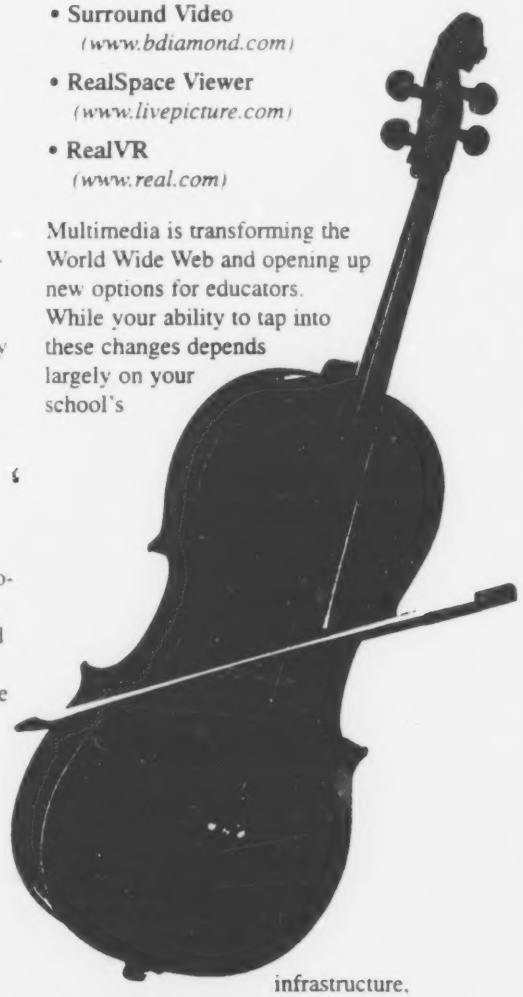
There are several competing technologies for running video on the Web. Your best selections are those needed at the sites you most want to visit. The choices below are presently quite evenly distributed.

- **QuickTime**; QuickTime for Windows *(quicktime.apple.com)*
- **RealVideo** *(www.real.com)*
- **VDO** *(www.vdolive.com)*
- **VivoActive** *(www.vivo.com)*
- **VXtreme Web Theater 2** *(www.vxtreme.com)*

3-D/Virtual Reality

Virtual reality is a way to create imaginary environments, or re-create places in the real world. These environments may include both contrived and filmed content, and give students experiences that can go far beyond reality.

- **QuickTime VR** *(quicktime.apple.com)*
- **Surround Video** *(www.bdiamond.com)*
- **RealSpace Viewer** *(www.livepicture.com)*
- **RealVR** *(www.real.com)*



Multimedia is transforming the World Wide Web and opening up new options for educators. While your ability to tap into these changes depends largely on your school's infrastructure, it's important to become familiar with these technologies now, in order to help guide, shape and evaluate their use in classrooms, schools and homes.

Odvard Egil Dyrli, a columnist and contributing editor for Technology & Learning, *is Professor Emeritus of Education at the University of Connecticut, and an education technology consultant.*

Authentic Achievement: The School Restructuring Study

Ideas & Directions, No. 5, March 1997

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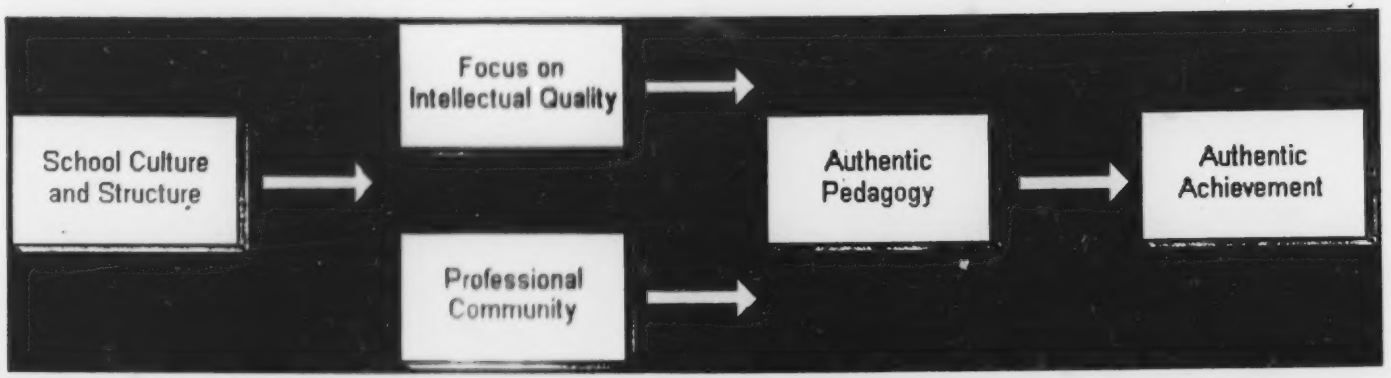
Authentic Achievement: Restructuring Schools for Intellectual Quality (Fred M. Newmann and Associates ; Jossey-Bass, 1996).

Authentic Achievement describes a vision for "authentic education" and identifies the enabling conditions under which authentic education can be realized. *Authentic Education* is one of several volumes reporting the results of the School Restructuring Study (SRS), a federally funded study which began in 1990. In addition to collecting data for over 800 schools and 10,000 students from 1990 to 1994, the School Restructuring Study looked intensively at 24 American schools.

Although "school restructuring" was a late '80s and early '90s buzzword, the authors define school restructuring in ways that will be familiar to progressive educators in both public and private schools. All of the schools studied were attempting to make significant and fundamental changes in one or more of four basic dimensions of schooling: student experiences; professional life of teachers; leadership, management, and governance; and coordination of community resources. Restructuring efforts represented a broad array of specific measures, including attempts to develop more personal student-teacher relationships; interdisciplinary studies; multidisciplinary team and multi-age cluster arrangements for students and/or teachers; the elimination of tracking and homogeneous grouping of students; block scheduling and longer, intensive class periods; alternative assessments, including extensive use of portfolios and performance exhibition; new articulated standards for student learning; participatory management and shared decision-making by administration, faculty, and rents; and extensive service-learning and community-based programs.

The authors of *Authentic Achievement* have tested some of their conclusions against the traditional achievement measures of educational outcomes, relying mostly on NAEP)National Assessment of Educational Progress) data. Although there are suggestions that in certain instances restructured schools have produced gains in student achievement, that has not been the authors' main objective. ***Authentic Achievement*** does demonstrate that organizing and structuring a school in ways that promote authentic teaching does lead to authentic learning. The greatest contribution the book makes is to define conceptions of authentic teaching and authentic learning and a model of schooling which realizes them. And they identify and discuss the critical conditions which permit or promote authentic teaching and learning to occur. While their conclusions are based on the intensive study of twenty-four schools (and background data on over 300 more). the authors give us richly detailed and illuminated portraits of six schools undergoing restructuring.

The book's overall conclusions can be summarized in the following paradigm:



Authentic Achievement and Authentic Instruction

Acknowledging that the kind of achievement traditionally required of students in schools is often trivial and contrived, the authors define authentic achievement in terms of intellectual accomplishments that are worthwhile, significant and meaningful. Narrowing to more refined definition of authentic achievement in school, the authors define authentic achievement in terms of three central requisites of significant intellectual accomplishment: construction of knowledge, disciplined inquiry, and the value of achievement beyond school.

The following tables, adapted from the text, describe authentic achievement and authentic instruction in greater detail.

Authentic Achievement	Authentic Instruction
Construction of Knowledge *Organization of Information* . Students organize, synthesize, interpret, explain complex information in addressing a concept, problem, or issue. *Consideration of Alternatives* . Students consider and evaluate alternative solutions, strategies, perspectives, points of view in addressing a concept, problem, or issue. **Disciplined Inquiry**	**Construction of Knowledge** *Higher-Order Thinking* . Instruction involves students in manipulating information and ideas by synthesizing, generalizing, explaining, hypothesizing, and arriving at conclusions that produce construct new meaning and understandings for them. **Disciplined Inquiry** *Deep Knowledge* . Instruction addresses central ideas of a topic or discipline with enough thoroughness to explore connections and relationships and produce relatively

Disciplinary Content. Students show understanding and/or ability to use ideas and perspectives considered central to academic or professional discipline(s).

Disciplinary Process. Students use the methods of inquiry, research, or communication characteristic of academic or professional discipline(s).

Elaborated Written Communication. Students elaborate on their understandings, explanations, or conclusions through extended writings.

Value Beyond School

Problem Connected to the World Beyond the Classroom. Students address concepts, problems or issues similar to those they have encountered or may encounter in the world beyond the classroom.

Audience Beyond the School. Students communicate their knowledge through performance, presentation, or other action for an audience beyond the teacher and classroom.

complex understandings.

Substantive Conversation. Students engage in extended exchanges with teacher and peers about subject matter in ways leading to improved and shared understanding of ideas or topics.

Value Beyond School

Connections to the World Beyond the Classroom. Students make connections between substantive knowledge and either public problems or personal experiences.

Given the closely linked, parallel, conceptions of authentic achievement and authentic instruction, it should probably not be a surprise that the study concluded that authentic instruction is highly correlated with authentic achievement. There are, however, some interesting conclusions within the book's analysis of the data. For instance, the data show that the authentic achievement model does not discriminate against any cultural group. The

model is equally applicable – and workable – with students from educationally disadvantaged settings as well as any other group. Students (and teachers) from all backgrounds and in all schools become significantly more engaged in the kind of intellectual challenges described above than in more conventional low-level school work.

Support for Authentic Education

The most significant and important of the book's conclusions are about the conditions which enable and promote the successful realization of the authentic education model. Authentic instruction was not occurring – or not to the same degree – in all of the restructured (or restructuring) schools studied. Schools where significant reorganization, innovative teaching and learning activities, and other restructuring efforts did lead to authentic instruction and achievement exhibited two significant characteristics: A central focus on intellectual quality; and a schoolwide professional community.

A central focus on intellectual quality does not require agreement about the standards or definition of what constitutes intellectual quality. But in the successful schools, issues of program implementation and organization did not prevent faculty and administration from seeing the school's intellectual focus as their central concern. Among the indicators of this central intellectual focus was a curriculum which includes challenging academic content. A major indicator was the kind of conversations among the school's faculty. Thus, a strong focus on intellectual quality was represented by serious faculty conversation on questions like:

- What cognitive processes to nurture in students?
- What subject matter is most important and least important?
- How material from the disciplines might best be integrated?
- How to balance basic skills training with in-depth understanding?
- What standards should be used to judge student work?
- How to improve assessment?

Equally important in enabling authentic education to grow out of restructuring was the existence of a schoolwide professional climate.

> Without the normative climate provided by a school professional community, making major pedagogical change is possible but very difficult. Authentic pedagogy presents a major challenge. It calls on teachers not simply to adopt specific techniques, but to make complex judgements about how to promote the intellectual qualities of construction of knowledge, disciplined inquiry, and value beyond school. There are no formulas, textbooks, or training programs. Instead, teachers must build innovative curriculum, try a variety of instructional practices, and continually revise their practice. School professional community offers the intellectual and social support necessary for success with authentic pedagogy.

Five elements of professional community were found to be significantly related to promoting the successful development of authentic instruction:

- *Shared Norms and Values* . Common assumptions and agreements about children, learning, teaching, teacher's work and roles, relationships and the collective good; beliefs about children's ability to learn; priorities about time and space.
- *Focus on Student Learning* . Faculty attention and energy addresses substantive issues of student achievement rather than more managerial and custodial aspects of schooling.
- *Reflective Dialogue* . Faculty exhibit a collective commitment to extensive and continuing conversations about curriculum, instruction, and student development, and to both self- and school-evaluation.
- *Deprivatization of Practice* . Teachers openly discuss and evaluate the effectiveness of their teaching practice, sharing feedback and insights with peers to develop collective understandings, kindling relationships that reduce autonomy while becoming committed to practicing the teaching craft more publicly.
- *Collaboration* . A natural consequence of reflective dialogue and deprivatization of practice. Teachers share expertise and ideas and contribute both to greater individual competence and to broader mutual understanding.

Continuing their analysis of the data a step further, the authors of *Authentic Achievement* asked about the conditions in schools that tend to encourage or inhibit an intellectual focus and a professional community. Both cultural (norms and expectations) and structural (organizational, procedural) conditions were found to be significant and, moreover, usually interacted in significant ways. The author's findings about the cultural and structural elements necessary for authentic achievement are summarized in the following table.

Cultural Conditions	Structural Conditions
Primary concern for the intellectual quality of student learning	Sustained time for instruction, planning, staff development, and student advising
Commitment to high expectations for all students, regardless of individual differences	Interdependent work structures for faculty, including teaching teams schoolwide decision-making committees
Support for innovation, debate, inquiry, and seeking new professional knowledge	School autonomy from regulatory constraints
Ethos of caring, sharing, and mutual help among faculty and between faculty and students, based on respect, trust, and shared power relations	Small size for school and instructional units

Learning in Hyperspace

William Winn, Ph.D.
University of Washington

University Teaching in the Information Age

Since their earliest beginnings, universities have acted as creators of information, as repositories for information and as places where people go to learn from information. University faculty and students add to the information about their disciplines through research. Universities gather and organize information in libraries and databases and provide access to them. And university departments offer courses which help students understand, organize and apply that information in a manner that is consistent with a program of studies.

In the past, universities have succeeded fairly well in these three tasks. Today, however, the ways in which information is created and made available are undergoing rapid and fundamental change. The Internet and the World Wide Web are making available in formation that has hitherto been inaccessible. They are making information available in many formats, not just written text and lecture, and in many places, including the home and the workplace, not just the lecture hall and laboratory.

Unfortunately for universities, the technologies that create and feed hyperspace are intended to make information accessible not to help people understand it. The "Information Highway" is just that, a conduit for information. Making sense of what it delivers, remembering it and using it are left entirely to the person receiving it. This means that as universities start to use modern information technologies as sources of information, the teaching role of the university must be reviewed and adapted to compensate for the Web's intrinsic inability to teach.

Before we can prescribe teaching strategies for hyperspace, we must understand how students learn. That knowledge will indentify for us what support students need when their sources of information are "out there" in hyperspace rather in the classroom with an instructor who can help students understand what the information means.

This presentation therefore examines three topics: how students learn; the potential of hyperspace to support learning; and, what we need to think about as we design web-based instruction.

How Our Students Learn

Learning is the process through which information becomes knowledge. Knowledge is not the same as memory. Our students must truly understand what they learn, not simply memorize it for a test. This means that they must construct mental representations of the content they are studying, often referred to as "mental models", that:

- Are sufficiently consistent with new information to allow its interpretation but are sufficiently flexible to adapt to novel interpretations.
- Are internally consistent.
- Allow the student to draw inferences when not all information is available.
- Allow the student to speculate about the world, to construct and test hypotheses that then serve as new sources of information.
- Allow students to describe what they understand to other people.
- Guide the student about where to look for information, how to search indexes and databases

productively and efficiently.

The key to constructing mental models is that students must interact with information, investing the appropriate amount of effort, in meaningful ways. This requires mental and sometimes physical activity on the part of students, activity which, unless properly directed, will be aimless and wasted. With experience, under some circumstances, university students are capable of directing their own learning activity. In the majority of cases, however, our students' activities need to be guided by good teaching that accompanies the presentation of information.

Three premises underlie our understanding of how students learn:

- **Knowledge is constructed by students.** Theories of knowledge construction, commonly referred to as "Constructivist Theories", describe psychological processes by means of which students build their own understanding of content. Understanding arises as students work to reconcile what they already know and believe with information they are encountering for the first time, or old information on which they are gaining a fresh perspective. Each student brings to this process a unique aggregate of prior experiences and understanding as well as a set of aptitudes and beliefs about the learning process itself. Constructed knowledge is, within limits, personal and idiosyncratic.
- **Knowledge is constructed in a context.** Knowledge construction never takes place in a vacuum and when students work with information devoid of a context, the knowledge that arises is inert and unconnected to what is meaningful to the student. Theories of "Situated Cognition" describe how the context in which knowledge is needed to determine how it is used. Theories of "Situated Learning" stress the need for knowledge construction to take place in a context that both connects new knowledge to what is already meaningful for the student and does so in a way that makes learning worthwhile.
- **Knowledge is constructed socially.** Although the knowledge our students construct is personal, there must be sufficient commonality of understanding so that they can communicate what they understand to other people. This can be achieved if students work together in the knowledge construction process. "Social Learning Theories" explain how this occurs. On the one hand, students shape their understanding of ideas to be more consistent with what others think if for no other reason than to make them more readily communicated. On the other hand, knowledge construction involves the social context in which information is created, learned and applied, for example the beliefs and expectations of a culture or the "culture" of a discipline, profession or organization.

The Potential of Hyperspace to Support Learning

In truth, students have always learned in this way. Lectures, readings and labs. provide many opportunities for constructing knowledge from information. Seminars, tutorials and even informal study groups provide opportunities to situate learning in contexts, including social contexts. However, the Web has made possible two changes in the way university instruction works that reduce or even remove these opportunities. The first is the growth of outreach programs where students study off campus often on their own. The second is the replacement of some in-class activitives by placing materials, such as lecture notes, on the Web. In each case, students may well receive the same information. In each case, university instruction may be made more accomodating to students who cannot get to campus or whose commitments make it difficult to attend classes when they are scheduled. However, formal or informal guidance about how to learn is no longer available unless faculty and instructional developers deliberately incorporate a variety of strategies into their on-line courses. These use the technologies of hyperspace to help students learn, and include:

- Providing specific guidelines about how to study on-line material, about what to look for at various web sites, about how to apply and assess newly-acquired knowledge.
- Providing useful paths through information by limiting the number of links students can follow from any one place.
- Designing pages so that student attention is directed to what is important and away from what is of secondary importance or merely embelishment.
- Using the entire repertoire of navigation aids so that students always know where they are, where they

have been, and how to get to where they need to go.
- Building interactive displays that provide feedback to students' actions.
- Providing easy and quick access to faculty and other students through email and chat facilities, ultimately establishing a virtual community where students can freely exchange ideas.
- Providing easy electronic access to other resources such as libraries, databases and laboratories.

Instructional Design for Learning in Hyperspace

The main focus of this workshop is instructional design. Subsequent presentations and activities will focus very thoroughly on this topic. For now, here are a few general questions to consider when we start to think about instructional design if the way we teach with the Web is to be consistent with what we know about how students learn.

- Is there any knowledge that simply cannot be acquired on-line or from resources other than a live teacher? If there is, then teleconferences or face-to-face meetings must be arranged.
- What kinds of guidance about how to process on-line information are students likely to need?
- To what extent is the sequence in which information is encountered important to knowledge construction? Page design and inter-page links must guide the path the student takes through the material.
- What kinds of interaction with on-line materials are desirable? Which are possible?
- Which information should be presented as text, pictures, graphics, video or audio?
- At what points is it most advantageous to arrange on-line or off-line discussions among students and faculty? Does it matter if all participants are not at the same place in a course when such discussions occur?
- Is it necessary to control the size of groups of students who interact on-line? How do you deal with reluctant participants?
- What other on-line resources do students need to access? When? How can they access them?

The Workshop

My presentation at the workshop will develop these ideas in such a way that their application to learning in hyperspace, through instructional design, will be apparent. My interactions with participants will allow me to clarify this theoretical framework and to give particular examples of its application.

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Return to Workshop Programs

Last modified April 1, 1997
Send comments or questions to mchambers@polaris.umuc.edu

Teaching in Hyperspace

Paul Lefrere, Ph.D.
Open University, Great Britain

This session builds upon the first keynote presentation (Learning in hyperspace) and also relevant questions raised during and after last Fall's IUC computer conference (see the discussions on Models and Frameworks for Web Course Design).

Teachers Are Learners Too

In the first keynote presentation, William Winn discusses three premises which underlie our understanding of how people learn:

- Knowledge is constructed by learners.
- Knowledge is constructed in a context.
- Knowledge is constructed socially.

Each of those premises applies to any learning experience, and is thus a justification for the participative format of this workshop, which should facilitate knowledge construction for all of us. What happens if instructors ignore those premises, and simply expose students to information, as in a traditional course? As we know, some students will find it hard to apply that information.

Ironically, a demonstration of this occurred on a course about hypermedia and constructivism. The people on the course could not create a hypermedia lesson that applied constructivist learning principles. Instead, they designed their lessons to be used in a step-by-step, linear approach and had difficulty seeing how these lessons could be presented in any other way. The knowledge in that group was 'inert' and 'compartmentalized'. Their knowledge was inert, since it had been acquired without understanding its relevance to an authentic teaching task, and so could not be accessed spontaneously in that context. Their knowledge was fragmented -'compartmentalized' - in the sense that not enough connections had been made by them between the newly taught concepts and their preconceptions about those topics.

Each of us has preconceptions about teaching and about the role of teachers. Also, each of us has our own organisational constraints, including the readiness of our colleagues and our students to countenance change. By sharing experience, views and kno wledge in this workshop, we can minimise the risk of compartmentalizing new knowledge about teaching, and we can identify ways to turn that knowledge to use, meeting real needs.

The Focus of This Presentation

The main focus of this presentation is on how to realise a constructivist approach to teaching in hyperspace, which is compatible with and builds upon constructivist approaches to teaching in the classroom. The goal is to enable participants to make in formed choices about teaching resources and teaching strategies, bearing in mind the mental models of their students; the needs and aspirations of those students; relevant research findings; and the experiences of other teachers who are using constructivi st approaches.

The small-group part of this workshop allows scope to consider other important issues not dealt with in this presentation, such as:

- The need for personal and institutional commitment to implement constructivist courses in hyperspace,

paying attention to the resource and training implications.

- The potential for re-using components of courses in other courses and institutions, and implications for intellectual property.
- Where to find teaching resources and 'communities of practice'.
- Whether and how to modify schemes for assessing students, bearing in mind the attitudes of students to assessment and grades.

Our Starting Point - Constructivism in the Classroom

Numerous books have been written about the constructivist approach to teaching, both in the classroom and, more recently, in hyperspace. Typically, these will list laudable aspirations for teachers, such as the following:

1. Encourage students to take responsibility for their own learning and become problem solvers, by accepting and encouraging student autonomy in framing questions and issues, and student initiative in answering them.
2. Involve students in real-world possibilities by encouraging them to use raw data and primary sources (in hyperspace and/or elsewhere), along with manipulative, interactive, and physical materials.
3. Frame tasks using terms with connotations of higher-level thinking, such as "classify," "analyze," "predict," and "create."
4. Allow student responses to drive lessons, shift instructional strategies, and alter content.
5. Inquire about students' understanding of concepts before sharing the teacher's own understanding of those concepts.
6. Encourage students to engage in dialogue, both with the teacher and with one another.
7. Encourage student inquiry by asking thoughtful, open-ended questions and allowing wait time after posing questions.
8. Seek elaboration of students' initial responses, so that students reach beyond a simple factual response and are encouraged to connect and summarize concepts by analyzing, predicting, justifying, and defending their ideas.
9. Engage students in experiences that might challenge their initial hypotheses and then encourage discussion.
10. Provide time for students to construct relationships, create metaphors and generate the abstractions that bind phenomena together.
11. Nurture students' natural curiosity through frequent use of a cycle of discovery, concept introduction, and concept application.

This is a daunting list, which begs many questions, few of which have been addressed in detail by researchers. Leaving that issue aside for the moment, there is a further issue of practicality: Is it feasible for faculty and instructional developers to adopt all of the ideas in a single course? As a corollary, What are the pros and cons of being selective? Those important questions are addressed, using as an example a course that stimulated students' interest in a subject in a mainly constructionist st yle but diverged from constructionism in three key ways:

- Students did not have autonomy in framing issues (cf. item 1).
- The content and instructional strategy was determined by instructors (cf. item 4).
- The course incorporated traditional exercises in its assessment.

Constructivism in hyperspace

Strong-sounding yet vague claims are often made about the merits of teaching in hyperspace. Here is an of such a claim, included here to stimulate small-group discussion: What is a "free range student?" It is simply a student fed on the wild grains and fragments available in the magical world made accessible by the Net... No more second hand knowledge. No more sage on the stage.

.udents will learn to make sense out of nonsense and order out of chaos. They will ask essential questions and solve complex problems. They will join electronically with brothers and sisters around the globe to cast a

spotlight on earth-threatening is sues which deserve attention and action.

By contrast, the rest of this presentation is rather staid and pragmatic: most of it considers the significant issues of choosing resources to make available to students, and what we need to think about as we design web-based instruction. Examples to be discussed include:

- Making abstract points in a meaningful way
- Providing guidance
- Finding resources that illustrate the evolution of knowledge, and its social construction, in a way that does not confuse novices
- Mental models and misconceptions
- Insights from research, in relation to providing students with worked examples.

The final issue to be discussed is evaluation of students. This is a contentious area. Some teachers adopt relatively radical approaches, such as examinations in which the class participates in preparing the midterm exam and scoring instructions for it. Other teachers ask questions such as: If more and more of the class work is being done on the net, how is a student's performance evaluated? Is there credit for discourse outside of classroom? Is there credit for research done on the net? How do you credit cross-university collaborative efforts on papers and research?

The Workshop

My presentation at the workshop Tuesday, May 20, 1997, will contextualise these ideas in particular domains of teaching in hyperspace, using grounded examples that participants can apply in other settings. My interactions with participants will aim to establish and sustain a community of practice concerning teaching in hyperspace, which is valued by each participant.

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Return to Workshop Programs

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Distributed Learning on the World Wide Web

by Steven Saltzberg and Susan Polyson

Today, most people think of the World Wide Web (WWW) as an ideal environment for information publishers. Universities use it to disseminate administrative and marketing information to faculty, students, alumni and potential students. Commercial use of the WWW is growing phenomenally as companies, large and small, jump on the bandwagon to market their products and services. But the WWW, in combination with other Internet tools such as Usenet Newsgroups, Email and Telnet, can be an interactive learning environment as well. And the creative implementation of these tools makes the WWW an ideal environment for distributed learning.

What is Distributed Learning?

Distributed Learning is not just a new term to replace that other (DL), distance learning. Rather, it comes from the concept of distributed resources. In computing we have been in the process of distributing computer power since the personal computer became a fact of life. Similarly, distributed staffing refers to the decentralization of the "warmware" experts that support the technology. Distributed Learning is an instructional model that allows instructor, students, and content to be located in different, non-centralized locations so that instruction and learning occur independent of time and place. The Distributed Learning Model can be used in combination with traditional classroom-based courses, with traditional distance learning courses, or can be used to create wholly virtual classrooms.

The WWW and Distributed Learning

The WWW by its very nature distributes resources and information, making the WWW the tool of choice for those interested in delivering instruction using a Distributed Learning Model. Indeed, it's not hard to find examples of faculty delivering their instructional materials on the WWW. (For the uninitiated, a good place to begin to look for these examples is the World Lecture Hall, http://wwwhost.cc.utexas.edu/world/instruction/index.html .)

Use of the Web for instruction ranges from basic information delivery to development of sophisticated virtual learning environments. Lets look at the two models on either end of this spectrum - The course supplement model, which exploits the Web's most basic features; and the virtual classroom model, showing the Web at its most sophisticated.

The Course Supplement Model

The majority of faculty who use the WWW for instruction, use their Web pages as an information delivery tool - the Web is a handy way to distribute standard course materials. In this model, faculty and students meet in the traditional classroom or telecourse where the lecture is delivered, while lecture notes, assignments, calendars, course syllabus, and other related materials are made available to students via the WWW. In this model, much of the instruction continues to be delivered synchronously (i.e., at a given time and place), though some asynchronous components are added - for example, electronic email communication among instructor and students. This model is an excellent way for faculty to be introduced to WWW technology and the concepts of Distributed Learning; and then to experiment by linking to other Web sites and using asynchronous components.

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The Virtual Classroom Model

At the other end of the continuum, a small, but growing number of faculty are moving beyond a basic information delivery model for the WWW; they are developing "virtual classrooms" where courses and entire degree programs are delivered in whole, or in part, over the WWW. These virtual classroom Web pages incorporate components such as:

- **Online lectures and instructional materials.** A web page can incorporate hypertext, images, sound, video, animation and the delivery of binary versions of spreadsheets, presentations and other documents. For example, the instructor can make available a PowerPoint presentation or an Excel Spreadsheet from a Web Page, and it can be viewed at every student's desktop; and this capability is transparent (the 'download' from the web server to the desktop occurs at the click of a button).
- **Interactive Multimedia Textbooks.** The Web allows for the creation of textbooks that integrate images, video and sound, and other binary files. These textbooks can include hyperlinks to encourage exploratory learning, or can remain linear to provide more content control.
- **One-to-One Communications.** Email between faculty and students can be integrated into the Web environment. The Web page allows email to be sent to faculty and classmates, and a Pop Mail system can be integrated for reading email messages. In both cases, email can include attachments of any binary file (e.g., word processing files, spreadsheets, graphic images, and even sound and video files).
- **Access to Remote Systems.** Links on a Web page can provide access to Library resources and other academic databases which require a login sequence.
- **Asynchronous Group Communcations.** The primary tool for interactive dialog is provided by Usenet news/discussion groups (similar to Bulletin Boards). This asynchronous tool allows faculty to post assignments, students to submit homework, and groups to work collaboratively on projects.
- **Synchronous Group Discussions.** Chat areas are virtual meeting places where students and faculty meet both formally and informally to discuss assignments, or accomplish group projects. They offer a great way to simulate a brainstorming session where all participants are actually (rather than virtually) present.
- **Experiential Learning.** Moos and Woos create a whole new world of experiential learning. This is accomplished by creating "virtual realities" where students and faculty can participate in role-playing and simulation exercises.
- **Course and Content Management.** The course's instructional content can be closely controlled, and involvement monitored using the flexible tools available on the WWW.
- **Online Testing.** The Forms capability on the Web allows faculty to create and grade tests online.
- **Online Assessment.** The capability of continually monitoring both the academic and technical abilities of the student can be built-in by establishing a standard query section.

In some cases, all aspects of the course or program are delivered asynchronously - faculty and students never meet at the same time or in the same physical space. However, most courses today implement some combination of the tools mentioned above and components of the traditional classroom or telecourse.

As the WWW technologies become more sophisticated and as the bandwidth of the Internet increases, there will be more tools, and more ways to develop creative Distributed Learning environments. In a very brief two years, the WWW has shown that it has the potential to be the premier vehicle for Distributed Learning which can enable and enhance both classroom instruction and distance learning.

The Benefits of Distributed Learning on the WWW

No doubt many faculty began experimenting with instructional uses of the WWW simply because it was there - and it was an interesting new environment to explore. But as many educators have found, the WWW and the Distributed Learning Models that it inherently supports, offer educators and institutions many benefits.

- **Student Centered, Collaborative Learning Environment**

Many of the Distributed Learning models implemented on the WWW emphasize a student centered environment and encourage greater collaboration among students. Emphasis is placed on interactive problem solving; the teacher is not just an expert, but increasingly takes the role of facilitator.

- **Convenience**

  Teaching and learning are not confined by space or time. Students and faculty can access the virtual classroom from their home or office. This is importance increasingly to many institutions interested in drawing non-traditional students into their programs.

- **Ease of Use**

  WWW navigation software (such as Netscape Navigator and Mosaic) nicely integrates access to all types of Internet resources in one easy to use interface. Both faculty and students can quickly and easily learn to use this software to navigate the Web, access course materials, post homework assignments and communicate with colleagues.

- **Development is relatively quick and easy**

  Developing instructional materials for the WWW is surprisingly easy and can be done relatively quickly. The skills of faculty who are using the WWW for instruction range from novice to sophisticated. Many faculty create their own very sophisticated WWW pages using HTML, the HyperText Markup Language that underlies WWW hypertext programming and linking. At some institutions (see Case Studies - VCU), programmers develop the basic design of a system and faculty need only have basic email and WWW navigation skills to enter assignments and communicate with students.

- **Resources readily available**

  The profusion of readily available source materials available on the WWW is ideal for education and research. The true beauty of the WWW lies in the ease with which you can create a hyperlink to existing information - allowing you to take advantage of the expertise and creativity of others without having to "reinvent the wheel." In addition, "human resources" are often readily accessible on the Internet - allowing you to enhance your virtual classroom with the introduction of guest speakers and content experts into your chat areas or discussion groups.

- **Ease of update and dissemination of information**

  Unlike printed resources, once materials have been posted to the WWW, information is easily updated and disseminated. The convenience and cost advantages of publishing information in this digital format are obvious.

- **Easy standardized access**

  Primarily available only to education, government and research institutions a year ago, today the Internet is readily accessible to almost anyone with a PC, a modem, and an Internet service provider. Commercial Internet service providers are now available throughout the country. The competition to provide service is resulting in very reasonable rates in both small and large cities. And software for accessing the Internet is readily available either by downloading directly from the Internet itself, or in computer stores and bookstores across the country. This easy access allows distance learners to readily access their course materials from their home or office computer. And because the Internet is based on standard communications protocols, you can be certain that students accessing the Internet in Maine will be able to use the same software as the students in Texas and the faculty in Virginia.

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Multimedia, Teleconferencing, and the Future

The World Wide Web is currently dominated by text and static graphics. Small sound and video files can be incorporated, but network speeds prohibit extensive use of these file types in the current environment. As the bandwidth of the Internet continues to expand, and as Internet technology increases in sophistication, the incorporation of dynamic multimedia technology and video teleconferencing into WWW pages will become pervasive. For education this increased use of multimedia means that faculty can deliver extremely sophisticated instructional materials directly to students both on campus and at the home or office as regularly as they send email today. It is clear that these maturing technologies will make Distributed Learning on the WWW increasingly important to higher education.

Site References

The Web Educational Site References is a list of Web sites that demonstrate some of the features of a Web-based learning environment described above.

The article, "Distributed Learning on the World Wide Web" was originally published in the September, 1995 issue of Syllabus magazine, and appears here with permission from Syllabus Press.

Interacting in Hyperspace: Developing Collaborative Learning Environments on the WWW

Linda M. Harasim, Ph.D.
Simon Fraser University, British Columbia, Canada

One of the basic requirements for education in the 21st century is to prepare learners for participation in a networked, knowledge-based economy in which knowledge will be the most critical resource for social and economic development. New communication technologies such as the Internet and WWW enable new approaches to and opportunities for teaching and learning. Networking can be used to enhance face-to-face classroom activities as well as to support entirely online course delivery, expanding access to quality education and interaction with peers, experts, and mentors.

The past decade of research in network learning has demonstrated important benefits: both increased access as well as enhanced opportunities for active student participation in collaborative learning and knowledge building. However, the use of new technology does not by itself guarantee improved educational outcomes. There is a critical need for rethinking education, with especial focus on new designs for learning as well as new designs for the technological environments that can support enhanced cognitive and socio-affective activities.

The recent introduction of the WWW and the explosion in its use highlights the need for new models of learning that can take advantage of the attributes of this medium and harness them for effective learning interactions. Educators need to reconceptualize and transform the WWW from a generic publishing environment into an environment especially customized for effective education based on powerful new principles such as interaction and collaborative learning.

The presentation will draw on almost two decades of research and practice in online education to identify lessons related to new models of how to create learning communities and collaborative learning projects online. It will also describe new tools that integrate to form new educational environments on the WWW.

Principles and Models of Online Education

There is a pressing need to shape the WWW into a learning environment by structuring and organizing online interactions based on advanced educational principles such as active and collaborative learning, and knowledge building. Collaborative or group learning refers to instructional methods whereby students are encouraged or required to work together on academic tasks. Unlike the teacher-centered models that view the learner primarily as a passive recipient of knowledge from an expert, collaborative or group learning is based upon a learner-centered model that treats the learner as an active participant. The conversation (verbalizing), multiple perspectives (cognitive restructuring), and argument (conceptual conflict resolution) that arise in cooperative groups may explain why collaborative groups facilitate greater cognitive development than the same individuals achieve when working alone [Sharan 1980; Slavin 1980; Webb 1982, 1989; Stodolsky 1984].

Knowledge building is a learning strategy in which active articulation, sharing and organizing of ideas and information into individual and group knowledge structures is encouraged. Koschmann et al. [1993] note that as knowledge is complex, dynamic, and interactively related, it is critical that instruction promote multiple perspectives, representations, and strategies. Scardamalia and Bereiter [1993] distinguish between knowledge reproduction strategies and knowledge building strategies which:

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"are, by contrast, focused centrally on understanding...In this view, learning---like scientific discovery and theorizing---is a process of working toward more complete and coherent understanding. The kind of discourse that supports such learning is not discourse in which students display or reproduce what they have learned. It is the kind of discourse that advances knowledge in the sciences and disciplines. It is the discourse of 'conjectures and refutations' as Popper called it." [pp.37-38]

Educational Outcomes

Analysis of data collected over ten years of application of this approach to graduate and undergraduate courses, delivered both entirely and partially online, indicates important outcomes such as active participation, peer interaction, multiple perspectives and divergent thinking. Problems associated with collaborating online, especially as related to information management and lack of educational supports, were also identified.

Significant outcomes of the experience with online collaborative course design were:

- Active learning: specifically, active participation by students.
- Interactive learning: specifically, in peer-to-peer discussion and exchange.
- Multiple perspectives: specifically, through reading input from all the other online students as well as the instructor.
- Metaphor: e.g., a spatial metaphor to facilitate the transition from traditional face-to-face classrooms to structured online classrooms.

Early field studies on networked learning environments suggest that it is important that participants form mental models of the "spaces" where they are working -- the virtual seminar, the virtual discussion group, the virtual laboratory, the cafe for social interactions, etc. [Feenberg 1993; Harasim 1993b]. This is important if they are to apply appropriate "social factors" to their interactions.

There was an urgent need to create network environments specially customized for education, which could facilitate easy adoption and adaptation (tailoring of individual courses) by the educators and which provide embedded tools to support specific instructor and learner activities. There was also a need for the development of discipline specific tools, to expand the types of course content that could be delivered over networks, especially such as those related to mathematics and lab-science instruction, and to the cultural and fine arts.

Virtual-UTM

Based on the decade of field research in online course delivery described above, the design and development of the system now known as Virtual-UTM was initiated in 1994 at Simon Frazer University. The goal was to provide a flexible framework to support advanced pedagogies based on principles of active learning, collaboration, multiple perspectives, and knowledge building, varied content areas including sciences and the arts, and varied instructional formats including seminars, tutorials, group projects, and labs [Harasim 1995]. The framework consists of tools to support core activities including course design, individual and group learning activities, knowledge structuring, class management, and evaluation.

The attention to pedagogy is what distinguishes Virtual-UTM from other virtual universities. The WWW has typically been used as a publishing environment characterized by a correspondence course model or a broadcast model of learning in which faculty post lecture notes or students post assignments online.

Functional Components to Support New Pedagogies

A major component of Virtual-UTM is the set of tools to support core activities including course design, individual and group learning activities, knowledge structuring, class management, and evaluation. Tools to support course design include a course structure tool and a group design tool. The course structure tool consists of a template for the course syllabus. Instructors fill in the template obviating the need for knowledge of HTML in constructing the syllabus. The group design tool facilitates the shaping of conferences for

effective online collaboration and communication.

VGroups, a Web-based conferencing system designed and developed by the Virtual-UTM team, mediates online group interaction. The annotation tool and the tool for creating concept maps provide ways of organizing ideas and structuring knowledge. The hypermedia environment also supports knowledge structuring through hyperlinks and multiple media. namely, text, graphics, images, video, and sound. An online grade book assists in class management. and evaluation is supported by the polling facility, conference logs, and logs of usage statistics.

Specific Supports for Online Collaborative Learning

Specific scaffolding such as templates are being developed as instructor and learner supports for online group learning activity. Based on research on learning network design (Harasim et al..1995), scaffolds for such activities as the following are bei ng built into Virtual-U, to facilitate easier and more effective group learning online:

- Electures and Team Presentations
- Seminars and Argumentation Protocols
- Debates -Formal and Informal
- Role Plays
- Project Teams
- Project-based Learning.

Currently fifteen institutions across Canada are using Virtual-U, primarily for university course delivery, but applications also include workplace training, adult education, and public (primary/secondary school) activities. Most courses employ a learner-centered collaborative learning approach, involving, for example, student-moderated online seminars, project teams, debates, virtual labs and projects which involve inquiry, goal-setting, group dynamics, analysis and reflection. The curricular areas include engineering science, communications, business, education, nursing science, labour, biology, language education, adult education and computer science.

[Dr. Harasim will demonstrate Virtual University-UTM authoring and delivery system at a technology session on Tuesday, May 20, and will discuss its features for supporting collaborative learning.]

[At her keynote presentation Wednesday morning, May 21, Dr. Harasim will comment on the research literature and discuss the lessons learned about online interactivity while designing and developing the Virtual U. Her full paper, only excerpted here, and its references will be available at the workshop.]

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CENTER FOR THE STUDY OF LANGUAGE AND INFORMATION

Just in Time Learning on the Internet

"Just-In-Time Learning on Internet" is a new term to describe ways of making instructional information available over Internet to people when they need it and at a level commensurate with their ability to understand it. Traditional text books and traditional teaching methods requiring weeks of study are being made obsolete by the information explosion. For example, leaders in continuing education for practicing professionals are moving away from traditional 10-week college class structure toward shorter "project-based learning" structures. The Internet offers an unprecedented opportunity deliver educational material of all sorts, given its use of hypertext, multimedia, real-time currency, and the remarkable depth of information available on it from around the world. The challenge we face in creating "just-in-time" learning delivery systems on Internet is to devise new ways of organizing and searching instructional material that exploits the Internet's unique powers, and furthermore is useable by everyone, especially those who have little or no formal education in technical matters.

Thus there are two problems must be solved: the first is that material on the Internet from scholarly and educational sources, or other potential educational sources, usually is *not* organized in a way that permits a novice learner to find "solutions". The second problem is that there are few standard search engines available to publishers of educational material that could help users locate "solution oriented" information whether or not Internet is used.

The Just-In-Time Learning on Internet project at CSLI is a new program whose purpose is to address both of these problems. CSLI plans to work with educational and scholarly publishers to develop new ways of presenting educational materials for use on the Internet (including, perhaps development of a "pay-per-question" system that will provide publishers with a financial incentive to develop on-line texts and journals in radically different ways than their traditional hard copy publications). Moreover, the CSLI researchers will carry out research in the development of indexing and query systems that interact through natural language dialogue with the user, helping as needed to clarify the question, and then guiding the user to the source of answers available.

Researchers

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From Presentation to Programming

Doing Something Different, Not the Same Thing Differently

Rather than using MicroWorlds just to do a presentation on dolphins, students use MicroWorlds to simulate a highly realistic ocean ecosystem complete with dolphins.

By Cathleen Galas

"Would you rather that children learn to play the piano, or learn to play the stereo?" asks Mitchel Resnick of the Media Laboratory at the Massachusetts Institute of Technology. "The stereo has many attractions: It is easier to play, and it provides immediate access to a wide range of music. However, 'ease of use' should not be the only criterion. Playing the piano can be a much richer experience. By learning to play the piano, children learn to express themselves in new ways. They can continue to learn and develop over time, adding new complexity as they improve. In doing so, they are more likely to learn more about the deep structures of music" (Resnick, Bruckman, & Martin, 1996).

Doing the Same Things Differently

In classrooms all over the country, overburdened teachers are rushing to provide "stereo" instruction to children. In other words, they are under the impression that children who use multimedia software on computers—rather than create their own materials—will learn more and learn better. Such instruction has been touted as necessary to help students move into the 21st century with the right technological skills.

Multimedia software may indeed allow students to present information. It is easy to use, and it can help students produce exciting presentations quickly and beautifully. Such programs offer a rich assortment of tools that help students present their learning; graphics, photographs, audio, and even video formats all enhance their presentations. Students can make their reports come to life with outstanding multimedia capabilities.

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These presentations, however, are still presentations. Using these multimedia tools, students are still just learning to play the stereo. For example, a stereo presentation on dolphins might show cards with images and information, and even hypertext buttons with dolphin sounds. These cards show the information researched and read by students. Children are doing the same things that students have done for many years—they're just doing them a different way. Their presentations are more exciting, motivating, and interesting because of the added features, but they are still just presentations.

Doing Different Things: Constructivist Technology

When students learn to play the piano, they use the instrument as a tool to create their own music. They spend time learning about music and eventually learn to manipulate musical structures, interacting with the piano and the music. Using a similar process—"tool" computer software—students can build and manipulate, rather than just present, and thus learn to play the piano. They use software to create their own environments that can be manipulated and changed.

For example, using MicroWorlds 2.0, which is based on the Logo programming language, children have built an ocean ecosystem complete with dolphins. They have been able to program "what if" situations and rules by which the ecosystem operates. If the food supply changes, so does the dolphin population. In this way, one group of students studied protective adaptative behaviors in marine animals. Dolphins threatened by sharks protected themselves and their offspring in unique ways (see Figure 1). These simulations of dolphins

required conceptual understanding, higher level thinking skills, and the ability to interact with the system according to its own special rules. This learning by building personal understanding is the basic tenet of constructivist philosophy.

An Instructional Paradigm for Doing Things Differently

Project-by-design programs, which are in the forefront of educational research worldwide and readily funded in the United States by the National Science Foundation (NSF), use technological investigative methods to help children learn to play the piano. These projects have similar design features: choice of topics, group collaboration, long-term projects, and artifact production (usually a project, model, or simulation). Most are at the middle school or high school level.

Project-Based Learning Environment

At Seeds University Elementary School, the laboratory school for the University of California at Los Angeles Graduate School of Education and Information Studies, students are working with computers and technology in a multiyear NSF project by design. Yasmin Kafai is the principal investigator; she is aided by graduate students Sue Marshall and Cynthia Ching and classroom science teacher Cathleen Galas. Using MicroWorlds, we have been working with fourth, fifth, and sixth graders to provide conceptual science explorations and experiences through student constructions of collaborative and interactive technology projects.

Overview of Project

When a project begins, students learn not only basic Logo programming concepts used in MicroWorlds 2.0 but also aspects of software design. Students get their first programming practice in teams. They learn how to use graphics tools, and how and why buttons are used to go a new page. They also learn the difference between using buttons or turtles, and that single-line instructions can be displayed when a program user connects with a turtle or button. Students practice creating text boxes and learn the basic commands to control the turtle. Finally, they learn that procedures are necessary to make more than one thing happen at the same time. Students are thus motivated to learn to make the following simple two-part procedure:

```
Procedure example:
to _________ (run)
end
```

More advanced programming occurs as students develop a need to know. They ask the teacher, other adults, or peers, or they check the available manuals to learn advanced programming techniques. For example, if a student wishes to show a change in the food supply, then he or she learns to program a "slider" that moves in either direction along the same axis to show an increase or decrease in the food supply. The programmer then writes in the rules, the "what ifs" that result if the supply changes. Users can move the slider to discover what

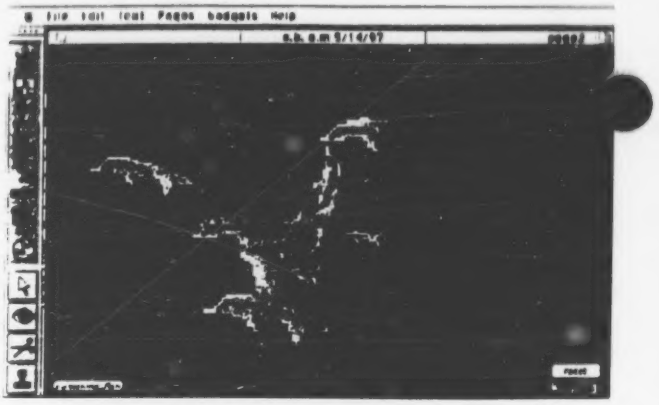

Figure 1. This screen illustrates a dolphin pod defense. Some dolphins move vertically up and down while others circle to keep the young dolphins close to the group. The tactic is confusing to the sharks.

happens in various food situations, thus building their understanding of food web relationships.

Second, a specific topic is introduced. As a group, students generate many "wonder" questions that can be refined into the students' personal "driving" questions of inquiry. Elliot Soloway, professor at the University of Michigan's Foundations of Science, uses this term to define deep, personally relevant inquiry questions that are suited for long-term, project-based science projects. Students fill out applications for team jobs and are assigned to teams of three to five students. Each team has a computer and an adjoining work area where planning boards and materials are available; here they start mapping out their ideas and timelines for their projects. Collaborative team-building activities help students work effectively in unison to construct their projects. Ongoing team-counseling activities help to resolve conflicts and mediate differences in individual student agendas.

Learning activities are large-group, small-group, and independent. Students may participate in some activities or experiments that the teacher assigns, and they may also design their own experiments, investigations, or research. The student-centered design and on-demand learning aspects of the projects require considerable teacher flexibility in this model. The teacher must not only understand the topics but also act as an information provider, guide, and interpreter. Before the unit, I collected many Web addresses for oceanography and marine biology sites, and then made them available to students from our own classroom Web site. In addition to discussing our experiment results, we examined the research found on the Internet and discussed the e-mail responses from marine biologists who worked with each group.

Third, students brainstorm their wonder questions in oceanography and marine biology. Small groups then meet to discuss specific research interests. A clipboard is available for students to write lesson requests. The first items on the list of our most recent marine biology unit were "food webs" and "how do animals adapt to different conditions in the oceans?" These request

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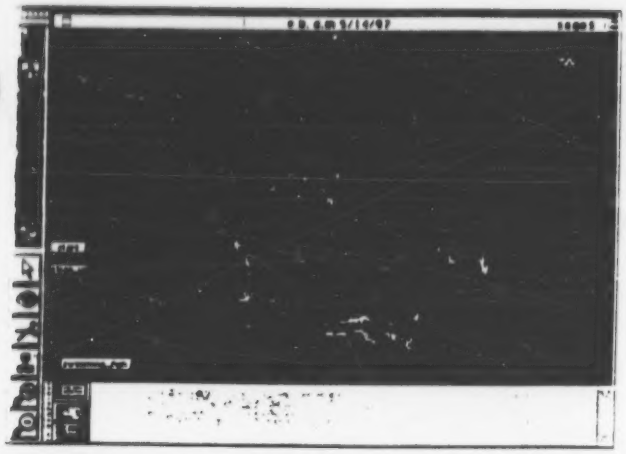

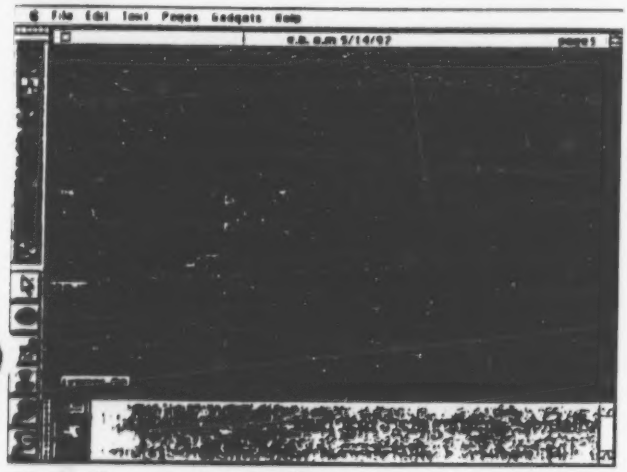

Figure 2. These screens show oil spilling into the ocean. The simulation shows dolphins ingesting the oil and the resulting toxic effects.

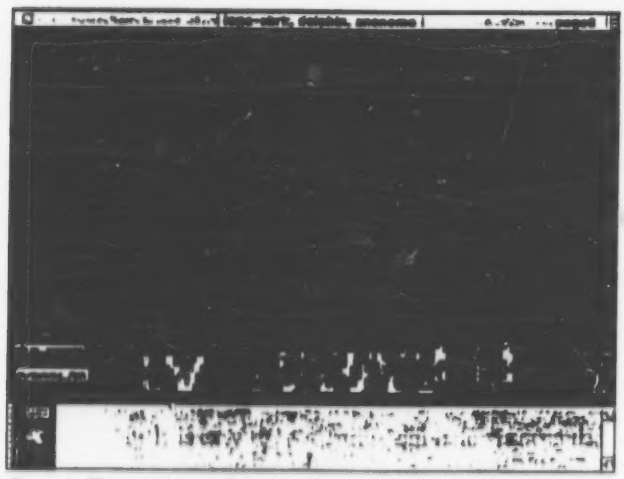

Figure 3. This simulation illustrates adaptive behaviors by showing clownfish safely swimming among sea anemones. The clownfish behavior attracts another fish, which believes the anemones to be safe. The fish is stung and eaten by one anemone.

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tems coincided with my overarching goals for student learning, so I planned specific lessons on food webs and adaptation.

Teacher-centered required lessons on ecosystems and current events led into a series of lessons and discussions requested by students. For instance, some expressed interest in human behavior effects on ocean life in Santa Monica Bay and along the California coast, and the discussion led them to oppose the expansion of a salt mine in Baja California, Mexico, because it had been predicted the project would have negative effects on gray whales in the area. Student activists then began independent research on ways to protect the ocean environment. Several group projects, in fact, revealed environmental-protection concepts. One project even animated an oil spill, showing the ensuing death of marine life in the area (see Figure 2).

Some experiments and activities were hands-on, and some were virtual (largely those developed through Internet resources). We took a real field trip on a research vessel and conducted various experiments on the water and ocean floor, viewed plankton through microscopes, and carefully gathered marine specimens for discussion. Other real and virtual field trips allowed us to view marine habitats, discuss adaptations, and learn more about human impact on the ocean environment. The entire class virtually dissected squid, identified whales on video, reconstructed marine mammal bones, and visited ocean museums. Students also asked to clean the beach on one of our real ocean visits. One project created after this trip showed a littered beach with a "clean-it-up" button. When a user clicked on the button, a hand actively picked up all of the trash on the beach and deposited it in a beach trash can.

In the classroom, we used the Internet as one resource for information and interactivity. To set the stage in oceanography, we began with whole-class activities that acquainted students with the world's oceans, the water cycle, and the ocean floor. Small groups met to view ocean color from space via the Internet, completing ocean map activities online and discussing and coloring maps using current satellite information. An online current activity allowed students to track real-life drifter buoys to see the directions of ocean currents. Students also took a virtual ocean habitats tour courtesy of the Monterey Bay Aquarium, interacted with ocean maps that showed trenches and tectonic-plate movement, and played an online aquatic environment game. When one student brought in his tadpoles for the class to observe, the entire class met to discuss coming changes. We looked together at pictures, diagrams, and videos available on the Internet, and then posted Web sites for interested students to pursue. Some groups explored the whole frog project, and some decided to participate in the virtual interactive frog dissection. Whole class lessons and activities were reserved for concepts that were important for all students. Activities were different for various groups, depending on their research questions; some activities were optional for those who were interested.

Students also are designing software for both their own learning and an audience. During the unit, students must show their projects to their groups, the class, and younger students as part of a "usability study." These younger students use the computer projects and give feedback to each group on the software's ease of use, what they learned, and whether the older students are communicating the understandings and knowledge well. These "reality checks" help students evaluate their progress, their goals, and, ultimately, their own learning.

Students Designing Software

Students who design software simulations and models learn about science in a way that connects information more meaningfully. Learning *about* dolphins brings a deeper understanding than studying disconnected facts about the kinds of dolphins and their diets and habitats. When students learn about dolphins and have to build and connect those pieces of research into a computer ecosystem, they learn the interrelationships of the information. When they explore how temperature, food supply, and numbers of predators in the environment combine to affect the dolphins' existence, the students learn about systems in science at a conceptual level, because they must understand connections and relationships if they are to construct an accurate model. When they just present information, they do not demonstrate true understanding. They are simply recalling information they have read or heard.

One major difference in project-by-design science is that students pursue their research and work on a project during the unit itself and not as a culmination activity after a science unit. Therefore, as students participate in teacher-directed activities or pursue their own research interests, they continually apply concepts to the structure of their project. Students must explain how the information or new ideas—their evolving understandings—relate to their project.

Bridge to Their Future

In many schools, teachers are scrambling to use technology in their curriculum. To meet a perceived demand, software designers are giving away stereo software for teachers to use. It reminds me of an ancient Chinese proverb: "If you give a man a fish, he has food for a day; if you teach a man to fish, he has food for a lifetime." If we just give our students presentation software, then our students will eat for a day. When we teach our students the skills to construct high-level, connected, and conceptual understandings, they can build their own bridge to the 21st century.

As a result, we will not be doing the same things differently, we will be doing different things with our technology. We will be providing tools that bring different outcomes. We will teach our children to fish and to play the piano. They will never be hungry, for they will feed on their own abilities to learn what is necessary to cross the bridge into the next century. We can give our students "piano" software tools that we can learn to play together. We can act as guides in the learning process instead of all-knowing information givers. We can respond to student questions on demand and help students discover and understand through their own investigations. In this way, our students may feast on a variety of wondrous music of their own creation, consuming their own and their peers' bountiful harvests of understanding, masterfully tickling the ivory keys of technology to manipulate, model, and simulate problems and solutions in the next century. As futurist David Thornburg suggests, we as teachers can truly provide students the real tools of technology to cross the bridge to their future instead of our past. ■

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Operationalizing Mental Models: Strategies for Assessing Mental Models to Support Meaningful Learning and Design-Supportive Learning Environments

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Abstract

Mental models are the conceptual and operational representations that humans develop while interacting with complex systems. Being able to reliably and validly operationalize users' mental models will help us to assess advanced knowledge and problem solving skills acquired while interacting with constructivist learning environments. Additionally, understanding effective and ineffective models will provide us advice for designing the kinds of scaffolding, modeling, and coaching that should be included in learning environments to support effective mental model deveelpment. This paper describes an initial study assessing the mental models of novice and experienced refrigeration technicians.

Keywords -- mental models, advanced knowledge acquisition, problem solving and transfer, designing constructivist learning environments.

1. Introduction

Most constructivist learning environments, including cognitive flexibility hypertexts (Spiro & Jeng, 1990), anchored instruction (Cogniton & Technology Group, 1992), goal-based scenarios (Schank (1993/1994), causally modeled diagnostic cases (Jonassen, Mann, & Ambruso,in press), share a common goal: the construction of advanced knowledge by learners that will support complex performance, such as problem solving and transfer of learning. These environments stress situated problem solving tasks, because those are the nature of tasks that are called on and rewarded in the real world. In most professions, people are paid to solve problems, not to memorize information.

While advanced knowledge, higher order thinking, problem solving, and transfer of learning evoke common associations and expectations in most of us, there remains an operational inexactitude in these constructs. Just how do we know when leaners have constructed advanced knowledge? How advanced or higher order does that knowledge have to be? How do we assess it? In this paper, I argue that these learning outcomes can best be operationalized and predicted by assessing and understanding learners' mental models of the problem or content domain being learned. Why? Because solving situated, ill-structured problems in different settings requires the solver to use complex and diverse mental representations. Problem solving performance can be at least partially explained by the quality of the mental models of the problem solvers (Gott, Benett, & Gillet, 1988).

The purpose of this paper is to begin to explore the utility of mental models as learning outcomes from using complex and situated learning environments. In order to provide useful recommendations, it is necessary to formulate clear and operationalizable representations of mental models and then to assess changes in those

models that may result from complex interactions with constructivist learning environments. If that is possible, then it will be potentially useful to reverse engineer appropriate types of structures in those environments to support the various kinds of mental model development that can be expected from those environments. This paper seeks to develop and asses an operational definition of mental models which can be used to assess advanced knowledge acquisition and transferable learning.

2. Mental Models

The construct, mental models, emerged from the human computer interaction field as a mental metaphor for describing the conceptions that humans develop for internally describing the location, function, and structure of objects and phenomena in computer systems. The facility with which users apply and exploit the functionality of computer systems depends, mental model theorists argue, on their conceptual models for describing the components and interactions of those systems. Are mental models merely conceptual? Mental models have been distinguished from other types of models that are also used to aid the development of user interfaces (Farooq & Dominick, 1988):

* **Cognitive Models.** Cognitive models are typically developed by cognitive psychologists, using information processing conceptions of skills and propositions, to describe the processes that humans use to perform some tasks such as solving problems, using a computer system, programming computers, etc. Among the most prominent cognitive models is the GOMS Model (Card, Moran, & Newell, 1983) that conceives of system-using activities in terms of Goals, Operators, Methods, and Selection rules (GOMS). Such models are task-specific and are often used to design interfaces and intelligent tutoring systems. They describe the goals, operators (processing activities), and methods needed to accomplish the goal state in terms of expert performance. Cognitive models, unlike conceptual or mental models, are not concerned with how users or learners actually conceive of tasks or systems.

* **Conceptual Models.** System designers often construct conceptual models of a system to show the users how they should conceive of the system. Mayer (1989) reviewed several of his own studies on the provision of conceptual models in learning BASIC, the camera, database systems, physics, and other content domains. He concluded that providing concrete, conceptual models for learners improves conceptual retention, reduces verbatim recall, and improves problem solving transfer. Showing learners how ideas are interconnected in the form of concrete models enhances the learners' mental models of the content being studied.

* **Mental Models.** Mental models are the conceptions of a system that develop in the mind of the user. Mental models possess representations of objects or events in systems and the structural relationships between those objects and events. Mental models evolve inductively as the user interacts with the system, often resulting in analogical, incomplete, or even fragmentary representations of how the system works (Farooq & Dominick, 1988). Unlike cognitive and conceptual models that describe how users should represent a domain or system, mental models describe how users or learners actually conceive of the system or domain. Moran (1981) expresses the belief of many designers that the design of the system controls the mental model that is developed by the user, so an ideal user's mental model would be congruent with the conceptual model of the interface as developed by the designers. However, Moray (1987) makes the argument that mental models evolve instead as homomorphs of the system's structure rather than isomorphs. Users' mental models usually vary, often significantly, from the cognitive or conceptual model promoted by the designers because of varying prior knowledge, individual abilities, and different beliefs about the purpose and functions of the system.

Although some claim that the term mental models relates only to conceptions of computer systems that users evolve, we agree with many psychologists that the concept is generalizable to most content domains and processes as well as general world knowledge. Mental models, according to Norman (1983), are the internal representations that humans develop of themselves and the objects they interact with in the world. Johnson-Laird (1983) believes that "human beings understand the world by constructing models of it in their minds." Building mental models is an important component in accommodating to the world, and to use a Piagetian construct, equilibrating differences between what is "in the world" and what is understood by the knower. That belief is institutionalized in the learning taxonomy developed by Kyllonen and Shute (1989), which contends that rote, didactic, deductive, and inductive learning methods result in the development of propositions and skills which form the basis for mental models. The construction of mental models "requires

the concerted exercise of multiple skills applied to elaborate schemata" (p. 132). Like all taxonomies of learning, propositions are prerequisite to the acquisitions of related schemas and skills, which in turn are prerequisite to mental models.

3. Operationalizing Mental Models

Mental models are theoretical constructs, so we do not know where and how they develop? A common theory for describing mental model development is analogical or metaphorical reasoning (Staggers & Norcio, 1993). That is, learners generalize existing models to new phenomena through a process known as structure-mapping, that is, mapping the old structural relations onto new (Gentner & Gentner, 1983). For example, flowing water helps most people develop a mental model for electricity. Most theories believe that mental models consist of objects and their relationships (Gentner & Gentner, 1983; Carley & Palmquist, 1992). The objects are concepts or nodes, and the relationships are links or verbs that state the nature of the relationships between objects. The node-link combinations are combined into networks or maps of relationships that describe the domain of knowledge represented by a mental model. All of these conceptions of mental models are based on a set of assumptions stated by Carley and Palmquist (1992):

(1) Mental models are internal representations.

(2) Language is the key to understanding mental models; i.e., they are linguistically mediated.

(3) Mental models can be represented as networks of concepts.

(4) The meanings for the concepts are embedded in their relationships to other concepts.

(5) The social meaning of concepts is derived from the intersection of different individuals' mental models.

These assumptions, we believe, are probably necessary but not sufficient for defining mental models.

3.1. Components of Mental Models

Generally, mental models are thought to consist of an awareness of the structural components of the system and their descriptions and functions, knowledge of the structural interrelatedness of those components, a causal model describing and predicting the performance of the system (often formalized by production rules), and a runnable model of how the system functions (Gott, Benett, & Gillet, 1988; deKleer & Brown, 1988).

Mental models have been assessed using a variety of methods, including think-alouds and verbal protocols, online protocols (audit trails), problem solving and troubleshooting performance, information retention over time, observations of system use, users' explanations of systems, and users' predictions about system preformance (Sasse, 1991). These data are often collected while users interact with experimental versions of systems, causing Sasse to conclude that such findigs are often flawed because the experimental scenarios are too restrictive and artificial, an insufficient range of information is collected, and samples are too small and too often reflect only novice users.

Mental models are more than structural maps of components. They are dynamic constructions. They are multimodal as well as multi-dimensional. Mental models are complex and inherently epistemic, that is, they form the basis for expressing how we know what we know. Because mental models are epistemic, they are not readily known to others and, in fact, not necessarily comprehended by the knower. Mental models, like all knowledge, must be inferred from performance of some sort.

3.2. Method

In this initial study, we will be studying the mental models of refrigeration technicians. We have selected a group of six novices (students in the final semester of a two-year, technical college program in refrigeration technology, and at least three experts (refrigeration technicians who have worked for six or more years for a major supermarket chain). All of the participants are male, between 20 and 38 years of age. For each

paticipant, we will present him with the description of a complex refrigeration problem. In the contextof that problem, we will collect the following kinds of data:

* **Structural knowledge.** Structural knowledge is the knowledge of the structure of concepts in a knowledge domain and can be measured in a variety of ways (Jonassen et al, 1993). A number of researchers have used structural knowledge methods to develop representations of mental models. For example, Pathfinder nets generated from relatedness data were generated to depict mental model (Kraiger & Salas, 1993). Carley and Palmquist (1992) use their own software for constructing interlinked concept circles (maps) based upon text analysis or interviews. These methods all rest on the assumptions that cognitive structure can modeled using symbols (Carley & Palmquist, 1992) and that semantic proximity can be represented in terms of geometric space (Jonassen et al, 1993). Using structural knowledge methods to model mental models further assumes that they can be represented as networks. In this study, we will use Pathfinder nets to analyze the structural knowledgeusig a constrained setof 20 refrigeration systems concepts. While we believe that networks of interconnected knowledge underlay mental models, they cannot function adequately as the sole means of representation.

* **Performance/Procedual Knowledge** It is essential that learners be required to perform problem solving tasks. Kyllonen and Shute (1989) recommend process outcome predictions for assessing mental models, that is, performing some task, such as troubleshooting a simulated task or "walking through" a performance test. "Running" the model has received limited investigation of simple concepts to qualitatively test the visual images in their heads (diSessa, 1983). These will be assessed using think-aloud protocol analysis while solving the problem provided. In addition to providing performance problems that need to be solved, learners should be required to articulate their plan for solving the problem, and they should be observed on how well they adhere to the plan, what stratgies they use for dealing with discrepant data and events, and finally what kinds of generalizable conclusion they can draw from the solution. These data can probaby best be gathered by having learners think aloud while solving the problem. We propose to intervene and prompt the learner at various stages with questions requiring them to explain or infer why certain results occurred and to make predictions about what will happen next.

* **Reflective procedural knowledge.** An increasingly common method for assessing mental models is the teach-back procedure, in which learners or users are asked to teach another learner (typically a novice) how to perform certain tasks or how to use a system. Students often produce a variety of representations, such as a list of commands, verbal descriptions of task components, flow charts of semantic components, descriptions of keystrokes (van der Veer, 1989).

* **Image of system.** Wittgenstein (1922) described propositions as imaginal models of reality. Most humans generate mental images of verbal representations. The statement, "The stone gained speed as it rolled down the steep slope" is meaningful only when an image of a mountain with a stone descending along its side is generated. Mental models definitely include mental images of the application of domain knowledge. So, it is important to elicit the learner's mental image of a prototype of the system s/he is constructing. Some learning environents accommodate this need by providing an "envisioning machine" that displays system objects in different views (Roschelle, 1987). However, such envisioning tools map representations or views of the world that may not be consonant with the learners'. So, in this study,we require learners to articulate and visualize their "runnable" physical models or the physical devices or processes (Gott et al, 1986) using interviews

* **Metaphors.** In addition to imaginal representations, humans naturally tend to relate new systems to exisiting knowledge, often by associating them with other physical objects. A recent interview with an engineer produced a "marshmallow" metaphor for molecules. While most metaphors are not as distinctive, they are important means for uunderstanding peoples' mental models. We will therefore require the participants to generate metaphors or analogies of the system involved in the performance,asking them to explain the similarities between the efrigeration system and the metaphor.

* **Executive knowledge.** It is not enough to have a runnable model of a domain or process, but in order to solve ill-structured problems it is essential to know when to run which model. Knowing when to activate mental models allows the learner to allocate and apply necessary cognitive resources to various applications.

This can only be assessed by presenting a variety of problems to solve. That is not possible in this initial study.

These data are currently being collected, and exerpts of these interviews will be used to illustrate this model in the conference presentation. The mental models of the participants will be evaluated using the following criteria.

3.3. Criteria for Evaluating Mental Models

Since mental models are process-oriented and relatively intangible, and since they need to be assessed using multiple data sources, an important goal of this research is to identify potentially useful criteria for assessing the quality and utility of individual mental models. A rational analysis of the construct suggests the following criteria:

CHARACTERISTIC	MEASURE
Coherence	Structural knowledge, Think-aloud
Purpose/Personal Relevance	Self-report, Cognitive interview
Integration	Cognitive simulation
Fidelity with Real World	Comparison to expert
Imagery	Generating metaphors, analogies
Complexity	Structural knowledge
Applicability/Transferability	Teach back, think aloud
Inferential/Implicational Ability	Running the model

4. Implications of Mental Models for Design Practice

We expect that these interviews will show that situated experience will be positively related to richer, more structurally coherent, and efficient mental models. We are currently negotiating contracts to design and develop case-based learning environments to support the refrigeration technology curriculum. The findings from this study, comparing the mental models of experts and novices, should provide directly relevant information about the nature of the scaffolding, modeling, and coaching that needs to be embedded in these environments, as well as providing us with measurement devices for assessing the advanced knowledge that we hope they will help learners to construct.

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Robert Logan's The Fifth Language—

A Look at Computers as a Language

By David Moursund

Robert K. Logan's recent book, *The Fifth Language—Learning a Living in the Computer Age*, brings an interesting new perspective to computers in education. Logan (1995) argues that computers (along with other related information technologies) constitute a language. He sees this language as the fifth in a series of languages that have developed over time. These languages include speech, writing, mathematics, science, and, now, computers. Logan argues that our educational system needs to be substantially modified to reflect the capabilities of computers as an aid to communication and human thinking.

What Is a Language?

People define the term *language* in many different ways. However, a generally accepted definition is that given by Vygotsky (1962), who described language as a vehicle for communication and thought.

Speech (natural language) is a powerful aid to communication and thought. Logan presents a carefully reasoned chain of arguments that the four other languages—writing, math, science, and computers—each satisfy the generally accepted definitions of language.

A Brief History of Languages

Logan's book also provides an informative summary of the history of the nonspeech languages. He notes that evidence of memory aids far precedes our earliest records of writing. For example, drawings and paintings on cave walls have been dated from more than 30,000 years ago. Tallies (for example, notches on animal horns) were in use more than 15,000 years ago.

Soon after the agricultural age began about 10,000 years ago in Sumer, a country located in the Middle East, agricultural societies began developing individual, uniquely shaped tokens that represented various agricultural products—a jar of oil, a measure of wheat, or a goat. At first, the number of tokens was small—perhaps 24 or so—but as agriculture grew more complex and cities began to develop, the number of tokens grew to as many as 190.

After about 5,000 years, the increasing size of cities and the complexity of agricultural activities made the use of tokens in the information-processing system impractical. Within the next 250 years, writing and mathematics were developed. These were powerful aids to the representation, processing, and communication of information. Because it takes considerable formal instruction and practice to learn writing and mathematics, schools were developed to teach what we now call "the three R's" to government and business clerks. (It is interesting to note that these schools used classrooms and had class sizes much like those in today's secondary schools.)

It took another 2,500 years before the methodologies for collecting, storing, processing, and communicating information overwhelmed the capabilities of the languages of speech, writing, and mathematics. This led to the development of science as an organized discipline—and as a language.

Writing, math, and formal science were tools used by a very limited number of people until technologies for the mass production of paper and books were developed by Gutenberg and others in the mid-15th century. These technological developments made it possible for a significant percentage of the population to gain the knowledge, skills, and power of writing, mathematics, and science.

Finally, it took until the 1930s (about 2,500 years after the development of science as a formal discipline) for the information explosion to overwhelm the languages of speech, writing, mathematics, and science. This information explosion led to the development of computers—the fifth language.

Computers as a Language

Logan bases much of his analysis on the work of Marshall McLuhan, a worldwide leader and visionary in communications. McLuhan coined the term "global village" and the phrase "the medium is the message." McLuhan and others have noted that new languages include their predecessors; they add new powers but lack some of their predecessors' powers. Thus, writing and mathematics did not replace speech, but they certainly empowered their users in ways far beyond the ways speech could.

Similarly, science, including its attendant features—the scientific method; the orderly collection, classification, and analysis of data; and model building—builds on and uses the languages of speech, writing, and mathematics. However, it too provides its users with tools and power far beyond what is provided by these other three languages.

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Computers as a fifth language builds upon the power inherent in the four preceding languages. Computers do not obviate the need for speech, writing, mathematics, and science. However, computers have engendered new tools for the acquisition, storage, processing, and communication of information. Interactive hypermedia and the World Wide Web are two obvious examples. Other examples include tools for composing and/or editing sound and video, software for graphic artists, systems for manipulating mathematical symbols, simulations in the sciences and social sciences, and medical imaging systems.

Educational Implications

It takes a lot of learning time and effort to develop a reasonable level of knowledge and skill in a language. For example, the acquisition of speech begins in very early childhood, and formal instruction in speech (rhetoric) often continues far into a person's educational life. Writing, mathematics, and science are part of the required curriculum in K–12 education and on into college.

Eventually it will become clear that learning computers as a language requires a similar amount of study and practice. In the near future, informal instruction in computers as a language will begin before students start school. Formal instruction will be built into the curriculum at every grade level and continue as part of a college education. All teachers will need to work with their students in the use of this new language.

Educators have a long way to go! Fortunately, many teachers now are comfortable enough in using computers that they can learn alongside their students as they implement new ideas in the classroom. To aid in this effort, ISTE-developed and NCATE-approved standards are in place for teacher education, both for classroom teachers and technology specialists. There is now and will continue to be a steadily rising tide of teachers who have knowledge and skills in the use of computers in education. ■

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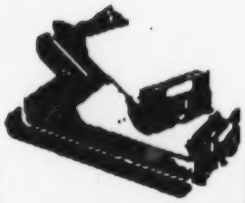

Universal Intellectual Standards

by Linda Elder and Richard Paul

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Universal intellectual standards are standards which must be applied to thinking whenever one is interested in checking the quality of reasoning about a problem, issue, or situation. To think critically entails having command of these standards. To help students learn them, teachers should pose questions which probe student thinking, questions which hold students accountable for their thinking, questions which, through consistent use by the teacher in the classroom, become internalized by students as questions they need to ask themselves.

The ultimate goal, then, is for these questions to become infused in the thinking of students, forming part of their inner voice, which then guides them to better and better reasoning. While there are a number of universal standards, the following are the most significant:

1. **CLARITY:** Could you elaborate further on that point? Could you express that point in another way? Could you give me an illustration? Could you give me an example?
   Clarity is the gateway standard. If a statement is unclear, we cannot determine whether it is accurate or relevant. In fact, we cannot tell anything about it because we don't yet know what it is saying. For example, the question, "What can be done about the education system in America?" is unclear. In order to address the question adequately, we would need to have a clearer understanding of what the person asking the question is considering the "problem" to be. A clearer question might be "What can educators do to ensure that students learn the skills and abilities which help them function successfully on the job and in their daily decision-making?"

2. **ACCURACY:** Is that really true? How could we check that? How could we find out if that is true?
   A statement can be clear but not accurate, as in "Most dogs are over 300 pounds in weight."

3. **PRECISION:** Could you give more details? Could you be more specific?
   A statement can be both clear and accurate, but not precise, as in "Jack is overweight." (We don't know how overweight Jack is, one pound or 500 pounds.)

4. **RELEVANCE:** How is that connected to the question? How does that bear on the issue?
   A statement can be clear, accurate, and precise, but not relevant to the question at issue. For example, students often think that the amount of effort they put into a course should be used in raising their grade in a course. Often, however, the "effort" does not measure the quality of student learning, and *when this is so* , effort is irrelevant to their appropriate grade.

5. **DEPTH:** How does your answer address the complexities in the question? How are you taking into account the problems in the question? Is that dealing with the most significant factors?
   A statement can be clear, accurate, precise, and relevant, but superficial (that is, lack depth). For example, the statement "Just say No" which is often used to discourage children and teens fro using

drugs, is clear, accurate, precise, and relevant. Nevertheless, it lacks depth because it treats an extremely complex issue, the pervasive problem of drug use among young people, superficially. It fails to deal with the complexities of the issue.

6. **BREADTH:** Do we need to consider another point of view? Is there another way to look at this question? What would this look like from a conservative standpoint? What would this look like from the point of view of...?
   A line of reasoning may be clear accurate, precise, relevant, and deep, but lack breadth (as in an argument from either the conservative or liberal standpoint which gets deeply into an issue, but only recognizes the insights of one side of the question.)

7. **LOGIC:** Does this really make sense? Does that follow from what you said? How does that follow? But before you implied this and now you are saying that; how can both be true?
   When we think, we bring a variety of thoughts together into some order. When the combination of thoughts are mutually supporting and make sense in combination, the thinking is "logical." When the combination is not mutually supporting, is contradictory in some sense, or does not "make sense," the combination is not logical.

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National
Educational
Technology
Standards
PROJECT

Introduction to the NETS Project

The NETS Project is an International Society for Technology in Education (ISTE) project
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NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS: GUIDING THE DEVELOPMENT OF NEW LEARNING ENVIRONMENTS FOR TODAY'S CLASSROOMS

New Learning Environments

Goals 2000 launched the nation on a course of school improvement through a process which focuses on high standards for student performances and development of local, state, and national plans for their achievement. Technology has been specifically identified as an area which must be addressed in these school improvement plans.

Parents want their children to graduate with skills that prepare them to either get a job in today's marketplace or advance to higher levels of education and training. Employers want to hire employees who are honest, reliable, literate, and able to reason, communicate, make decisions, and learn. As educators, we must provide learning environments that not only convey important and relevant content, but also facilitate the types of behaviors that will help students ultimately become employable and self-directed learners.

During the schooling process, students must be provided environments for learning that help them:

- communicate using a variety of media and formats,
- access and exchange information in a variety of ways,
- compile, organize, analyze, synthesize information,
- draw conclusions, make generalizations based on information gathered,
- use information and select appropriate tools to solve problems,
- know content and be able to locate additional information as needed,
- become self-directed learners,
- collaborate and cooperate in team efforts, and
- interact with others in ethical, honest, and appropriate ways.

Although these essential learnings are not specifically technology skills or knowledges, technology can be used quite effectively to address them. Teachers know that the wise use of technology can enrich classroom environments and shape strategies for achieving these marketable skills.

The arena that directly affects student achievement is the classroom. Parents, school leaders, and employers increasingly voice expectations that classroom instruction must extend beyond the traditional factory model to provide new learning environments. These classrooms should use technology to facilitate thinking and decision-making which are necessary in today's workplace.

National Educational Technology Standards

The National Educational Technology Standards (NETS) Project, partially funded by the National Aeronautics and Space Administration (NASA) in collaboration with the U.S. Department of Education, OERI, and the National Science Foundation, is designed to develop technology performance standards for PreK-12 students, establish specific applications of technology through the curriculum, provide standards for support of technology in schools, and address student assessment and evaluation of technology use to improve learning. The project's goal is to enable, through coordination and technical expertise, major stakeholders in PreK-12 education to develop national standards for the educational uses of technology that will facilitate school improvement in America. ISTE has joined with other leading professional education organizations in the National Educational Technology Standards (NETS) Project. Partner organizations include:

- American Federation of Teachers (AFT)
- American Library Association (ALA)
- Association for Supervision and Curriculum Development (ASCD)
- Council of Chief State School Officers (CCSSO)
- Council for Exceptional Children (CEC)
- International Society for Technology in Education (ISTE)
- National Association of Elementary School Principals (NAESP)
- National Association of Secondary School Principals (NASSP)
- National Education Association (NEA)
- National School Boards Association (NSBA)
- National Fund for Improvement of Education (NFIE)
- Software Publisher's Association (SPA)

Liaisons representing major curriculum groups will participate in the development of technology standards for their subject areas. These curriculum liaisons will participate in standards development work sessions designed to identify standards relating specifically to each curriculum area and to build interdisciplinary connections among the curricular areas. Joining the partner organizations in this project are representatives from:

- International Reading Association (IRA)
- National Council for Geography Education (NCGE)
- National Council for the Social Studies (NCSS)
- National Council for Teachers of Mathematics (NCTM)
- National Council for the Teachers of English (NCTE)
- National Science Teacher's Association (NSTA)

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The *Performance Domains* provide a framework for defining particular *Performance Indicators* and the grade ranges where specific skills are likely to be introduced, reinforced, and mastered. The *Profiles of Technology Literate Students* provide broad descriptors of technology competence that students should exhibit upon completion of the target grades. The competencies must be introduced,, reinforced,, mastered,, and finally integrated into an individual's personal learning and social framework. A profile for each of four grade ranges provide broad statements of what students finishing each grade range should know about and be able to do with technology. The four profiles address the following grade ranges:

- PreK- Grade 2
- Grades 3-5
- Grades 6-8
- Grades 9-12

Each subsequent profile builds on those preceding it. The sequence of development in knowledge and skills in using technology culminate in profiles relating specifically to the five educational technology skills domains as indicated by the bracketed numbers following each profile item.

All three of these documents are included in this kit and are available for your review and response at the International Society for Technology (ISTE) Webpage (http://www.ISTE.org).

These documents may be used to facilitate solicitation of input on these standards from a variety of individuals. Results from standards will inform the development of benchmarks for student achievement and progress with respect to the use of technology to support teaching and learning. The final standards documents will provide essential, realistic, and attainable goals for using technology tools in the context of curricular content.

National Educational Technology Standards PROJECT

Performance Domains
Profiles of Technology Literate Students

- Grades PK-2
- Grades 3-5
- Grades 6-8
- Grades 9-12

The NETS Project is an International Society for Technology in Education (ISTE) project
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Profiles of Technology Literate Students
Overview

A major component of the standards project is the creation of general profiles of technology literate students at key developmental points in their pre-college education. These profiles provide rather broad descriptors of technology competencies that students should have developed by the time that they exit the target grades.

These profiles reflect the underlying assumptions that all students should have the opportunity to develop technology skills that support learning, personal productivity, ethical and responsible behaviors, decision-making, and daily life. They prepare students to be lifelong learners and make informed decisions about the role of technology in their lives.

These profiles are indicators of achievement at certain points in K-12 education. Technology skills are to be developed by coordinated activities that support learning throughout a child's education. They must be introduced, reinforced and finally mastered and integrated into an individual's personal learning and social framework. The profiles reflect the following basic principles and assumptions:

1. Students acquire steadily increasing skills and knowledge related to the use of technology for enhancing personal and collaborative abilities.
2. Student acquire steadily increasing ability to make quality decisions related to managing their own learning.
3. Students acquire steadily increasing skills to work in collaboration with others, with hardware and software and information resources, and to solve problems with the support technology tools.
4. Students become responsible citizens and users of technology and information.
5. Students have access to current technology resources including telecommunications and multimedia enhancements
6. Students acquire skills that prepare them to learn new software and hardware technology and to adapt to the complex technology environments that emerge in their lifetime.

Technology skills can be divided into five broad domains. The profiles and associated performance indicators can be viewed within the framework of these domains. They include:

Domain 1. Basic Operations and Concepts
Domain 2. Social, Ethical, and Human Issues
Domain 3. Productivity Tools
Domain 4. Technology Tools for Communications
Domain 5. Research, Problem-Solving, and Decision-Making

These profiles and specific performance indicators being developed provide benchmarks of student achievement and progress with respect to the use of technology. They are essential, realistic, and attainable goals for lifelong learning and productive citizenry as we head into the next century of American education.

EDUCATIONAL TECHNOLOGY PERFORMANCE DOMAINS

Domain 1. Basic Operations and Concepts. There is a basic framework of concepts and skills essential for effectively using technology tools and resources. These concepts and operational skills provide a foundation for use of technology to support learning throughout the curriculum. Students have a sound understanding of the operation of technology systems, terminology, basic concepts, limitations and uses of technology, connectivity and compatibility concepts, and an awareness of adaptive/assistive technologies. Students develop attitudes toward technology use which support life-long learning, collaboration, personal pursuits, and productivity.

Domain 2. Social, Ethical, and Human Issues. The rate of change surrounding technology is staggering. Students understand the historical and societal impact that technology has had, is having, and is likely to have. They understand worker issues related to automation and retraining. Students evaluate new information resources and technological innovations based on their appropriateness to specific tasks and the individual's personal preferences, requirements and resources; they are sophisticated technology consumers. Students understand privacy, copyright, licensing, and intellectual property rights issues, and they make responsible decisions and exhibit ethical behavior related to them.

Domain 3. Productivity Tools. There is a set of universally used tools that support both individual and group work. These tools underlie more complex, specific, and emerging technologies. Students are well versed in the use of these tools to support their productivity in a wide variety of endeavors. Topics in this domain include word processing, database, spreadsheet, utility programs, telecommunications, multimedia (graphics, animation, digital video, sound, authoring, presentation), content-specific software and tools, emerging technologies, groupware, and collaborative process tools.

Domain 4. Technology Tools for Communications. The teacher and the textbook are no longer the sole sources of information in the classroom. Students obtain information from a variety of sources and media. Students use their knowledge of information tools to deal with the exponentially increasing and rapidly changing sources of information available to them. Topics in this domain include traditional and emerging research skills, remote information resources, electronic communication, distance learning and teleconferencing, networking, and research skills.

Domain 5. Technology Tools for Research, Problem-Solving, and Decision-Making. The environment that our graduates will face when leaving the school system is increasingly complex. Therefore, the strategies for success must be more sophisticated. As students progress through school, they continuously improve their abilities to combine and match technology tools and resources to meet the learning challenges they encounter. Students apply effective strategies to assess the credibility of information sources and to resolve conflicting information. Topics in this domain include locating technology tools and information about them, using specialized personal productivity tools, self-monitoring of effectiveness, developing collaborative skills, resolving information conflict, critically consuming information, and using intelligent agents and sophisticated search techniques to support research, problem-solving, and decision-making.

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EDUCATIONAL TECHNOLOGY STANDARDS
PROFILE OF A TECHNOLOGY LITERATE STUDENT COMPLETING GRADE 2

By completion of Grade 2, students will:	Agree	Disagree	Unclear	Comments
1. Use input devices (e.g., mouse, keyboard, remote control) and output devices (e.g., monitor, printer) to interact with computers, CD players, VCRs, and other types of technology. **[1]**	A	D	U	
2. Use a variety of media (e.g., CD-ROM, TV, video tapes) for learning and leisure-time activities. **[1]**	A	D	U	
3. Use appropriate terminology when communicating ideas about technology used in the P-2 setting. **[1]**	A	D	U	
4. Use age-appropriate interactive multimedia resources (e.g., interactive books, educational software, elementary multimedia encyclopedias) to support learning. **[1]**	A	D	U	
5. Work cooperatively with peers and family members when using technology in the classroom and at home. **[2]**	A	D	U	
6. Demonstrate positive social behaviors when using technology. **[2]**	A	D	U	
7. Exhibit respect for technology systems and software. **[2]**	A	D	U	
8. With support from teacher, parent, or partner, develop simple multimedia products. **[3]**	A	D	U	
9. Use technology resources (e.g., writing tools, drawing tools, logical thinking programs, puzzles, and games) for problem solving, communication, and illustration of thoughts, ideas, and stories. **[3] [4] [5]**	A	D	U	
10. With support from teacher, parent, or partner, use telecommunications to gather information and communicate with others. **[3] [4]**	A	D	U	

Additional comments or suggestions:

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EDUCATIONAL TECHNOLOGY STANDARDS
PROFILE OF A TECHNOLOGY LITERATE STUDENT COMPLETING GRADE 5

By completion of Grade 5, students will:	Agree / Disagree / Unclear	Comments
1. Use common input and output devices (keyboard and others) efficiently and effectively. **[1]**	A D U	
2. Discuss common uses of technology in daily life and the advantages those uses provide. **[1] [2]**	A D U	
3. Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use. **[2]**	A D U	
4. Use general purpose productivity tools (e.g., word processor, graphics program, database program, spreadsheets) to support student productivity and learning throughout the curriculum. **[3]**	A D U	
5. Use multimedia authoring/presentation tools and peripherals (e.g., digital cameras, scanners, audio/video devices) to support student productivity and enhance learning throughout the curriculum. **[3]**	A D U	
6. Use technology tools (e.g., productivity tools, multimedia or hypermedia authoring tools, simple graphing software) and resources (e.g., interactive encyclopedias, content specific CDs, web pages, databases) for individual and collaborative writing, communication, and publishing activities. **[3] [4]**	A D U	
7. Use telecommunications to access remote information and communicate with others in support of learning and for pursuit of personal interests. **[4]**	A D U	
8. Use telecommunications and on-line networked systems (e.g., on-line discussions, groupware, video conferencing) to develop collaborative team projects and to participate in group problem-solving activities. **[4] [5]**	A D U	
9. Use technology resources (e.g., calculators, probes, CD-ROMs, videos, educational software) for problem-solving, self-directed learning, and extended learning activities. **[5]**	A D U	
10. Associate common technology tools with the types of tasks for which they can be used. **[5]**	A D U	

Additional comments or suggestions:

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EDUCATIONAL TECHNOLOGY STANDARDS
PROFILE OF A TECHNOLOGY LITERATE STUDENT COMPLETING GRADE 8

By completion of Grade 8, students will:	Agree / Disagree / Unclear	Comments
1. Apply strategies for troubleshooting routine hardware and software problems that occur during everyday use. **[1]**	A D U	
2. Discuss current changes in information technologies and the impact those changes have on today's workplace and society. **[2]**	A D U	
3. Exhibit legal and ethical behaviors when using information and technology, and discuss consequences of misuse. **[2]**	A D U	
4. Use content-specific tools and software (e.g., environmental probes, simulations, graphing calculators, exploratory environments) to support learning and research. **[3] [5]**	A D U	
5. Use hyperlinked multimedia tools and integrated productivity tools to design, publish, and present individual and group student products. **[3] [4] [5]**	A D U	
6. Use collaborative tools and activities to develop and produce individual and team projects. **[3] [4] [5]**	A D U	
7. Design and develop individual or group Web documents that demonstrate and communicate curriculum concepts. **[4] [5]**	A D U	
8. Use telecommunications to collaborate with students, experts, and others at distant locations to investigate curriculum-related concepts, issues, and information. **[4] [5]**	A D U	
9. Select appropriate technology resources to illustrate and solve problems and to accomplish tasks. **[5]**	A D U	
10. Use technology resources to research and select appropriate data and information concerning real world problems. **[5]**	A D U	

Additional comments or suggestions:

EDUCATIONAL TECHNOLOGY STANDARDS
PROFILE OF A TECHNOLOGY LITERATE STUDENT COMPLETING GRADE 12

By completion of Grade 12, students will:	Agree	Disagree	Unclear	Comments
1. Make wise and discriminating consumer choices among technology systems and services. [1] [2]	A	D	U	
2. Identify capabilities and limitations of emerging and state-of-the-art technology resources and assess the potential of these systems and services to address personal and learning needs. [2]	A	D	U	
3. Analyze advantages and disadvantages of widespread use and reliance on technology in the workplace and in society as a whole. [2]	A	D	U	
4. Advocate legal and ethical behaviors among colleagues and acquaintances regarding the use of technology and information. [2]	A	D	U	
5. Use technology tools and resources for managing finances, schedules, and personal/professional contact information. [3]	A	D	U	
6. Identify technology resources, including distance and distributed education, to support life-long learning. [5]	A	D	U	
7. Routinely use on-line services to meet information access, research, publication, communications, and group productivity needs. [4]	A	D	U	
8. Select and use technology tools for research, information analysis, problem-solving, and decision-making. [5]	A	D	U	
9. Investigate uses of expert systems, intelligent agents, and simulations in real world situations. [5]	A	D	U	

Additional comments or suggestions:

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RUBRICS

for the

Assessment
of

Information Literacy

Based on the Information Literacy Guidelines
for
Colorado Students, Teachers
and
School Library Media Specialists

cde
Colorado Department of Education

State Library and Adult Educatio n Office
201 E. Colfax Avenue
Denver, CO 80203

CEMA
Colorado Educaitonal Media Association

6/96

An explanation of rubrics, and their application in standards education

The Information Literacy Rubrics are an extension of the Model Information Guidelines (1994; Colorado Department of Education, State Library and Adult Education Office, Colorado Educational Media Association).

A **rubric is** a descriptive measurement for defining what a learner should know, and can do. This document was created to define the knowledge and ability of every student in how they:

- Construct meaning from information.
- Create a quality product.
- Learn independently.
- Participate as a group member.
- Use information and information technologies responsibly and ethically.

The rubrics are designed in a *matrix*, or grid of benchmarks which define the information literate student . The far left column contains the *Target Indicators* , or the individual components of each of the five information literacy guidelines. Each target indicator is followed by four qualities , or key behavior skills, to be measured. These are written in student language, beginning with a minimal level of understanding, labeled In Progress, followed by Essential, Proficient, and Advanced. Page 1 is an overview for all five guidelines; pages 2 - 8 address specific benchmarks. The final page is a checklist for a student or teacher which may be used in the assessment process.

It should not be a goal to have each student attempt to achieve the Advanced level in each skill area on each project. Rather, the goal should be to assess students on the *key points* important to the specific content area task, and *understand the process* for applying that skill in other curricular work. [Example: In a task involving the knowledge seeking process, the student might first be assessed in determining information needs, and acquiring the information. In a later task, they could be assessed in the organization, processing, and evaluation of the information].

The ideal application and use of these assessments is in a collaborative curriculum involving the student, teacher, media specialist, and other stake holders in the school environment. These rubrics can be used as written to define information goals for the student, or as a framework for student/teacher-written assessments. They are applicable to all grades and content areas, but only through a cooperative effort between the key players will they be truly effective in ensuring student buy-in to understanding the information literacy process.

Knowing how to apply these skills is necessary for successful living
in the twenty-first century, and beyond.

Information Literacy Rubrics Writing Team, Dec.-Jan. 1995

Marcene Amend -- Poudre School District
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Carole Chauffe -- Pueblo City 60
Kay Evatz -- Adams District 12
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Kathy Williams -- SE Colorado BOCES
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Colorado State Board of Education

Seated January 10, 1995

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Colorado Department of Education Mission:

"To lead, to serve, and to promote quality education for all"

William T. Randall
Commissioner of Education
State of Colorado

Nancy M. Bolt
Assistant Commissioner
State Library and Adult Education Office
201 E. Colfax Avenue
Denver, CO 80203
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Purpose of this publication: To provide meaningful examples of what a learner should know and can do, in the context of information literacy. These rubrics are designed to be used by any stakeholders in education: media specialists, teachers, administrators, staff, students, and parents.

Funding for this project was provided by the Colorado State Library and Adult Education Office, and the Colorado Educational Media Association (CEMA). Nongovernmental sources are funding 25% of this project.

Target Indicators	In Progress	Essential	Proficient	Advanced
Student as a Knowledge Seeker	• I need someone to tell me when I need information, what information I need, and help me find it.	• Sometimes I can identify my information needs. I ask for help finding and using information.	• I am able to determine when I have a need for information. I often solve problems by using a variety of information resources.	• I know my information needs. I am confident that I can solve problems by selecting and processing information.
Student as a Quality Producer	• Someone else sets the standards and I try to create a product to meet them.	• I may need help understanding what makes a good product, and support to create it.	• I compare my work to models and use them as an example for my product.	• I hold high standards for my work and create quality products.
Student as a Self-Directed Learner	• I have trouble choosing my own resources and I like someone to tell me the answer.	• I might know what I want, but need to ask for help in solving information problems.	• I choose my own resources and like being independent in my information searches.	• I like to choose my own information resources. I am comfortable in situations where there are multiple answers as well as those with no answers.
Student as a Group Contributor	• I need support to work in a group. I have trouble taking responsibility to help the group.	• I usually participate with the group. I offer opinions and ideas, but can not always defend them. I rely on others to make group decisions.	• I participate effectively as a group member. I help the group process, and evaluate and use information with the group.	• I am comfortable leading, facilitating, negotiating, or participating in a group. I work with others to create a product that fairly represents consensus of the group.
Student as a Responsible Information User	• If I find information I can use I copy it directly. I need to be reminded about being polite and about sharing resources and equipment with others.	• I usually remember to give credit when I use someone else's ideas. It is okay for others to have different ideas from mine. I try to be polite and share information resources and equipment with others.	• I do not plagiarize. I understand the concept of intellectual freedom. I am polite and share resources and equipment with others.	• I follow copyright laws and guidelines. I help others understand the concept of intellectual freedom, and can defend my rights if challenged. I acknowledge and respect the rights of others to use information resources and equipment.

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Students as Knowledge Seekers: Information Guideline #1 (Part 1)

Target Indicators	In Progress	Essential	Proficient	Advanced
Determines Information Needs	• I need someone to tell me the topic and what information I need.	• I need someone to define the topic. I can identify, with help, some of the information I need.	• I determine a topic and identify the information I need.	• I determine a manageable topic and identify the kinds of information I need to support the topic.
Develops Information Seeking Strategies and Locates Information	• Someone else selects the information resources I need and shows me how to find the information. • Someone else develops my plan and timeline. • I do not know what to record when doing research, nor what bibliographic information is.	• I select resources but they are not always appropriate. • I have an incomplete plan. I have a timeline, but don't always stick to it. • I return to the same source to find the bibliographic details.	• I use a variety of information strategies and resources. • I have a complete plan and stay on my timeline. • I sometimes record bibliographic information.	• I always select appropriate strategies and resources. • I have a complete plan and can adjust my timeline when needed. • I always record bibliographic information for all my sources.
Acquires Information	• I don't understand how to use information resources. • Someone helps me extract details from information.	• I do not use a variety of information resources. • I can extract details and concepts from one type of information resource.	• I prefer to limit the number of information resources I use. • I extract details and concepts from different types of resources.	• I am comfortable using various information resources. • I extract details and concepts from all types of resources.
Analyzes Information	• I have no way to determine what information to keep, and what to discard. • Someone helps me decide what information to use.	• I sometimes apply appropriate criteria to decide which information to use. • I don't always know what criteria to use.	• I examine my information and apply criteria to decide what to use. • I usually know what criteria to use.	• I effectively apply criteria to decide what information to use. • I can match criteria with needs.

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Students as Knowledge Seekers: Information Guideline #1 (Part 2)

Target Indicators	In Progress	Essential	Proficient	Advanced
Organizes Information	• I try to organize information, but have trouble and have to ask for help. • I need to be reminded to credit sources.	• I know some ways to organize information. I can use one or two very well. • Sometimes I credit sources appropriately.	• I organize information in different ways. • I usually credit sources appropriately.	• I choose to organize information in a way that matches my learning style and/or to best meet my information needs. • I always credit sources appropriately.
Processes Information	• I put information together without processing it.	• I combine information to create meaning. I draw co nclusions.	• I integrate information from a variety of sources to create meaning that connects with prior knowledge I can draw conclusions on my own from my sources	• I integrate information to create meaning that connects with prior knowledge and draw clear and appropriate conclusions I provide specific and supportive details
cts on Information	• I am not sure what actions to take based on my information needs. • I ask for help to find everything I need.	• I know what to do with the information I find. • Some of the information I find is appropriate to my needs.	• I act based on the information I have collected and pro cessed. • I do this in a way that is appropriate to my needs.	• I act independently of the information I have collected and processed • I do this in a way that is appropriate to my needs. I can explain my actions so that others understand
Evaluates Process and Product	• I don't know how I did. I need someone to help me figure out how to improve.	• I know how well I did and have a few ideas on how to improve next time.	• I know when I've done a good job, and know when there are things I could have done better. I make some revisions.	• I evaluate the product and the process throughout my work, and make revisions when necessary

Students as Quality Producers: Information Guideline #2

Target Indicators	In Progress	Essential	Proficient	Advanced
Recognizes Quality and Craftsmanship	• I need help understanding what makes a good product, and how to create it.	• I look at the available products and sometimes see what is needed to create my own.	• I look at several products, evaluate them, and know what I need to do.	• I look at several products provided to me by my instructor, critique them, and see ways to make a better product.
Plans the Quality Product	• I need help to understand the steps needed to plan my work. I like someone to help me with each step in completing the product.	• I need to be shown the steps to make my plan, and then can work on my own.	• I know the steps necessary for completing my product and make a plan to complete it.	• I create a process and a timeline (with a back-up plan) for all the steps needed to complete my product.
Creates a Quality Product	• I need help to find which sources to use. I don't know how to use the facts to solve the problem. I have trouble creating the product.	• I use the minimum sources assigned. I just list the facts. I always use the same sources for other work.	• I create and improve my product by using a variety of resources from the media center or school.	• I compare and contrast facts from a variety of sources available both in and out of my community. I am comfortable using various media for products and audiences. I discover new sources on my own.
Presents a Quality Product	• My product is incomplete. I don't revise.	• I complete, but need help with revisions to my product.	• I complete, practice, and revise my product.	• I complete, practice, and revise my product several times. I ask others to give me feedback.
Evaluates Quality Product	• I don't know how to make my product better.	• I need help to understand the best part of my product, and what could have been improved.	• I understand why my product is good, and what could make it better.	• I exceed my expectations when producing and improving a quality product.

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Students as Self-Directed Learners: Information Guideline #3

Target Indicators	In Progress	Essential	Proficient	Advanced
Voluntarily Establishes Clear Information Goals and Manages Progress	• Setting information goals is difficult for me. • I need help from someone to choose what I'm supposed to do. • I work best with problems that have only one answer.	• I can set some information goals by myself. • I can sometimes find what I'm supposed to do on my own. • I see that sometimes there may be more than one solution for my project or problem.	• I almost always set my own information goals. • I can usually find a variety of information resources to achieve those goals. • When there is more than one solution, I choose the appropriate one for my project or problem.	• I can set my own information goals, and choose the best way to achieve them. • I like to explore and evaluate various resources and solutions. I use them to create a new solution to the problem. • I'm comfortable in situations where there are multiple answers, or no "best" answer.
Voluntarily Consults Media Sources	• I usually use the easiest source, and only one source.	• I can do what is asked of me, and usually find answers to questions after consulting a few sources.	• I understand how different sources are organized, and look for the ones that best meet my needs.	• I look at many different sources to find those that meet my needs. I consider various point-of-view and the merits of the resources before choosing those that work best for me.
Explores Topics of Interest	• I have trouble enjoying my reading, and have a hard time staying with a book -- or other reading material. • I tend to over-use certain information resources to the exclusion of others when I do read. • I have trouble exploring new topics. Someone needs to help me get started.	• I enjoy reading certain types of books and other information resources. • I usually read only about one subject, or stay with one author's works. • I explore new topics when required.	• I like reading several different types of literature. • I enjoy reading in a variety of formats (e.g. books, CD-ROM, and other media). • I read to explore and learn about a variety of topics.	• Reading is very important to me, and I enjoy reading and exploring many different topics. • I use information resources for information and personal needs, and actively seek answers to questions. • I consider alternative perspectives and evaluate differing points of view. • I read for pleasure, to learn, and to solve problems.
Identifies and Applies Personal Performance Guidelines	• I just do what I'm told. Someone tells me if it's good or not.	• I know when I've done a good job.	• I know when I've done a good job, and know why I was successful. I am satisfied with the results.	• I know how I learn best, and can choose the method(s) which guarantees my success. I can evaluate what I've done. I'm not always satisfied with my results.

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Students as Group Contributors: Information Guideline #4

Target Indicators	In Progress	Essential	Proficient	Advanced
Helps Group to Determine Information Needs	• I do not participate constructively in a group. • I sometimes distract the group. •I rely on others to decide what information is needed.	• I usually participate to determine the information needs of the group.	• I am willing to do what is needed to help determine the information needs of the group.	•I assume my appropriate role in the group. • I am comfortable leading, facilitating, negotiating, or participating in defining the information needs of the group.
Shares Responsibility for Planning and Producing a Quality Product	• I am not a part of the group, and/or rarely take responsibility to help plan the group's information needs.	• I help define the jobs, and assume some responsibility in assisting with task compl etion.	• I help to define jobs, and am actively responsible in helping to complete the task.	• I help the group go beyond the basic resources. • I am responsible for helping synthesize the ideas into a finished product.
Collaborates to Determine Relevant Information	• I have trouble participating in a group, or take over and don't listen to the ideas of others.	• I sometimes participate in selecting, organizing, and integrating information for some sources.	• I work with others to select, organize, and integrate information from a variety of sources.	• I actively work with others and help the group select, organize, and integrate information from a variety of sources.
Acknowledges Diverse Ideas and Incorporates them When Appropriate	• I need support to work in a group. I often do not respect input from others.	• I show respect for the ideas of others.	• I encourage team members to share ideas.	• I respect and help the group find and incorporate diverse ideas.
Offers Useful Information to the Group, Defends Infor-mation When Appropriate, and Seeks Consensus to Achieve a Stronger Product	• I sometimes make the group's progress difficult.	• I offer information or ideas, but am unable to defend my own ideas, or those of others.	• I offer and defend information that is brought to the group.	• I offer useful information to the group, defend that information when appropriate, and seek consensus to achieve a stronger product.
Clearly Communicates Ideas in Presenting the group Product	• I choose not to participate in the presentation, or am unprepared to make a good presentation. • Sometimes I am disruptive.	• I help in presenting the group product.	• I contribute to the group and demonstrate the ability to use a variety of presentation met hods.	• I work hard in assuring that all contributions from the group are included in the final product. • I help the group present effectively using a variety of media.
Evaluates Product, Process, and Individual Roles Continuously	• I don't work with a group and am not certain how to evaluate the process or pro duct.	• I evaluate my own role, but need support to apply certain criteria to the group product. • I am more comfortable allowing others to do the work.	• I effectively evaluate my own role and the roles of others. • I continuously apply appropriate evaluation criteria to the group product.	• I work with the group to evaluate roles, and apply appropriate evaluation criteria to process the product. • I suggest improvements for the next project.

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Students as Responsible Information Users: Information Guideline 5

Target Indicators	In Progress	Essential	Proficient	Advanced
Practices Ethical Usage of Information and Information Sources	• I don't give credit to others when I use their information. • I don't know why some things need quote marks, and have trouble putting information in my own words. • I don't know why I can't use other people's work (from books, or other information resources).	• I can usually put information in my own words. • If I use someone else's words, I usually remember to put them in quotes. • I can create a bibliography to credit my sources, and don't copy other people's work. • I know it's against the law to copy computer disks, tapes, or other materials.	• I follow copyright laws and guidelines by giving credit to all quotes and ideas, citing them in notes and bibliography properly. • I only make copies of print, software, or tapes when I can locate permission from the author/publisher, or by locating permission on the materials.	• I understand and appreciate that copyright protects the creator of the resource, so I always follow and uphold copyright regulations. • I do not plagiarize. • I cite all my sources by following a format demonstrated to me by a teacher or other source. • When I need to copy something, I know how to, and do get permission from the copyright holder.
Respects Principle of Intellectual Freedom	• I usually don't pay attention to what others read, listen to, or view, and sometimes react inappropriately to them.	• I don't try to keep someone from expressing their own ideas, nor reading, listening to, or viewing what they want.	• I understand it is important to have many and differing perspectives on a subject. • I know I have the right to express my opinion, and usually offer my opinion in an appropriate manner.	• I can explain my First Amendment rights, and if challenged, know the process available to me to defend those rights. • I promote the rights of others, and defend them as well.

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arget Indicators	In Progress	Essential	Proficient	Advanced
ollows Guidelines nd Etiquette when Using Electronic Information Resources	• Someone tells me how to use the information resources, and works with me to get the information I need. • I spend so much time using the resources that I deny access for others. • I need to be reminded of the guidelines for using electronic resources responsibly.	• I have been trained to use electronic resources, can use them with minimal supervision, and can usually get the information I need without help. • I share electronic resources and try to follow appropriate guidelines for their use.	• I get the information I need in a reasonable amount of time so others can also use the m aterials. • I follow guidelines for the use of information resources and use them efficiently.	• I serve as a mentor for others who want to learn how to use electronic r esources. • I use my skills to promote positive and ethical uses of those resources. • I use the materials and equipment fairly and carefully.
Maintains the hysical Integrity of Information Resources and Facilities	• I know that information resources / facilities have rules and consequences, and sometimes I follow those rules.	• I usually follow the rules in my school for use of information resources, and accept the consequences when I occasionally break a rule. • I never intentionally cause damage to any materials or equipment.	• I respect the rights of others by following the rules, and never intentionally keep materials from being available to them. • I tell someone immediately about any damage I cause or discover.	• I appreciate the many resources and facilities that are available to me. • I help others follow the rules for the use of equipment and materials. • I use materials fairly, carefully, and equitably. • I suggest new rules when appropriate.
ecognizes the Need or Equal Access to Materials and Resources	• I use some information resources. • Sometimes I only use items from home or my classroom, but might go to the library media center during a sche duled class time. • I don't care if someone else needs to use the information I have. • I don't like to share.	• I go the library media center when I need information resources. • When my library doesn't have what I need, I know I can ask the media specialist/librarian to help me find it from another source.	• I know it is important for others to have access to information r esources, so I usually return items when the are due. • When I need other materials that are not in my school, I look for them on ACLIN, or other suitable networks, and work with my library media specialist to borrow from other sources.	• I use several libraries and on-line sources when necessary and appropriate to find information I need. • I share resources with others when it is helpful. • I follow the rules in all buildings, including returning all materials on time.

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Anybody can establish a web site --and they do!
How do you evaluate the sites you see???

Sources used for this Session:

- Critical Evaluation of a Web Site: Secondary School Level
  http://www.capecod.net/schrockguide
- Evaluating and Designing a Web Site
  http://library.uwaterloo.ca/standards/webdesign.html
- Evaluating Information
  http://www-ed.fnal.gov/lincon/eval.shtml
- Evaluating Information Found on the Internet.
  http://milton.mse.jhu.edu:8001/research/education/net.html
- Evaluating Internet Research Sources
  http://www.sccu.edu/faculty/R_Harris/evalu8it.htm
- Evaluating Internet Resources: A checklist
  http://infopeople.berkeley.edu:8000/bkmk/select.html
- Evaluating Internet Sources
  http://acs.ucalgary.ca/UofC/departments/INFO/library/netsearch/evaluation.html
- Evaluating Online Information
  http://volvo.gslis.utexas.edu/~kidnet/evalinfo.html
- Evaluating the Quality of Internet Information Sources
  http://itech1.coe.uga.edu/Faculty/gwilkinson/webeval.html
- Evaluating Quality on the Net
  http://www.tiac.net/users/hope/findqual.html
- Evaluating Sites on the World Wide Web
  http://bvsd.k12.co.us/~blackl/rely/frontpage.html
- Evaluating Web Pages: Links to Examples of Various Concepts
  http://www.science.widener.edu/~withers/examples.htm
- Evaluating Web Sites: Criteria and Tools
  http://www.library.cornell.edu/okuref/research/webeval.html
- Evaluating World Wide Web Information.
  http://thorplus.lib.purdue.edu/library_info/instruction/gs175/3gs175/evaluation.html
- How to Critically Analyze Information Sources
  http://urisref.library.cornell.edu/skill26.htm
- Quality of Information.... and disinformation online
  http://blake.oit.unc.edu/~rbstepno/disinfo.html
- Teaching Students to Think Critically About Internet Resources
  http://weber.u.washington.edu/~libr560/NETEVAL/index.html
- The Web as a Research Tool: Evaluation Techniques
  http://www.science.widener.edu/~withers/webeval.htm
- Thinking Critically about World Wide Web Resources.
  http://www.library.ucla.edu/libraries/college/instruct/critical.htm
- Thinking Critically about World Wide Web Resources That You Design
  http://library.cmsu.edu/lis5000advanced/week1/pageeval.htm
- WWW CyberGuide Ratings for Content Evaluation
  http://www.cyberbee.com/guide1.html

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Evaluation Questions for Web Sites (a compilation from the sources listed)

Authority
- Who is the author, producer, or developer of this site?
- What is the author's credentials (educational background, occupation, experience, past writings)?
- How knowledgeable is the individual or group on the subject matter of the site?
- Is any sort of bias evident?

Affiliation
- What institution or Internet provider supports this information?
- Is there existence of quality control over the information appearing ?
- Is the site sponsored or co-sponsored by other individuals or group?
- Has this site been recognized as a top site by other organizations?
- Does the author's affiliation appear to bias the information?

Audience
- Who is the intended audience?
- Is the publication aimed at a specialized or a general audience?
- Is it too elementary, too technical, too advanced, or just right for your needs?

Current
- When was the information created or last updated?
- What indications are available that this material is kept current?
- If material is presented in graphs and/or charts, is it clearly stated when the data was gathered?

Content - Purpose
- Who is the audience?
- What is the purpose for this information (to inform, to explain, to persuade)
- Is the site supposed to be educational or entertaining?
- Is this site meant to be informational or promotional?
- Does the information appear to be valid & well-researched, or is it questionable & unsupported?
- How complete and accurate are the information and the links provided?
- Is the content objective and impartial?
- Is the content free of emotion-rousing words and bias?
- What other resources (print & non-print) are available in this area?
- Does the work update other sources, substantiate other sources, or add new information?
- Does it extensively or marginally cover your topic?
- Is multimedia appropriately incorporated?
- What is the intrinsic value of this site?

Structure
- Does the document follow good graphic design principles?
- Do the graphics and art serve a function or are they decorative?
- Does the text follow basic rules of grammar, spelling and literary composition?
- Is there an element of creativity, and does it add to or detract from the document itself?
- Can the text stand alone for use in text only Web browsers as well as multimedia browsers?
- Is attention paid to the needs of the disabled -- e.g., large print, graphics, audio?
- Are relevant links provided to Web "subject trees" or directories?

Comparisons
- What does this work/site offer compared to other Internet sites?
- Given all the above information is this Internet site useful and relevant?

THE UNIVERSITY OF CALGARY

The University of Calgary Library

"... connecting people and information"

http://acs.ucalgary.ca/UofC/departments/INFO/library/netsearch/evaluation.html

There is a lot of valuable information on the Internet, but there is no overall quality control. Anyone can put up a web site and post whatever information they want. In using information from the Internet it is a case of user beware. This is actually no different from using information from other sources (eg, books) - the user should always be careful to assess the reliability of the source before trusting the information content. Some things to look for in evaluating web pages and other Internet sites are the following:

Date

- More critical in subject areas where change is rapid
- Date of posting or date of last updating may be given at top or bottom of page
- If not posted, date of last modification can often be determined using the document information feature of your browser.
- Dates of updating can be misleading - were some changes made at that date or was whole document updated?
- One means of checking whether the site is up-to-date is to check whether the links on the page point to existing sites or whether they point to sites that have moved or are no longer available at the URL given on the page

Author

- Is there an author indicated for the information and is there a link to the author's qualifications, home page, etc.
- Institutional pages may lack a personal author but still be reliable
- Can you find out information about the author by searching the web or from non-Internet sources?

Institution

- Is the page part of a contribution from an institution?
- Is the page linked to the institution's home page and vice versa?
- Individuals may have home pages on an institution's server but not be a part of the institutional
- What type of institution is it and do you consider it to be a reliable source?

Content

- How comprehensive does the source appear to be?
- Is there a bibliography?
- Are links provided to outside independent sources?
- Is the page for some purpose other than the provision of information (eg, for advertising purposes or for expressing an opinion)?
- Do you sense any bias in the page?
- Does the content generally agree with what you have found elsewhere, including in books and other non-Internet sources? If the web page is the only place where you have found the information, you should be very careful in evaluating the source or you should check elsewhere to find a second source that is in agreement. The effort expended in evaluating the source should depend on the importance to you of the information in the source.

WWW CyberGuide Ratings for Content Evaluation

http://www.cyberbee.com/guide1.html

Kathleen McLachlan, Library Media Specialist at East Knox High School, Ohio developed these guides to use with teachers and students to evaluate content and graphic design of home pages. **Note**: I've taken the liberty to make minor modifications.

Title of site:_____

URL (address):_____

Evaluate the Web site you are considering for instructional use according to the criteria described below. Place your rating of: 1 (Poor) or 2 or 3 or 4 or 5 (Excellent) in the box provided.

1. Speed

☐ The home page downloads efficiently enough to use during whole class instruction.

☐ The home page downloads efficiently enough to keep students on task?

2. First impression - general appearance

☐ The site is designed attractively and will entice my students to further exploration.

☐ The site is designed clearly enough to be successfully manipulated by my users.

3. Ease of site navigation

☐ My students will be able to move from page to page, link to link, item to item with ease, without getting lost or confused.

☐ All links are clearly labeled and serve an easily identified purpose.

☐ Links provided to other pages and sites operate efficiently enough to keep my students on task.

4. Use of graphics/sounds/videos

☐ The graphics/sounds/videos are clearly labeled clearly identified.

☐ The graphics/sounds/videos serve a clear purpose appropriate for my intended audience.

☐ The graphics/sounds/videos will aid my students in reaching the desired objectives for using this site.

5. **Content and/or Information**

- ☐ This site offers a wealth of information related to my stated objectives.
- ☐ The information is clearly labeled and organized and will be easily understood by my students.
- ☐ The content of linked sites is worthwhile and appropriate for my intended audience.
- ☐ The content of linked sites adds to the value of this site for achieving my instructional goals.
- ☐ The information providers are clearly identified.
- ☐ The information providers are reliable.
- ☐ The content is free of bias, or the bias will be clearly recognized by my students.
- ☐ This site provides interactivity which increases its instructional value.

6. **Currency**

- ☐ The site was recently revised.

7. **Availability of further information**

- ☐ A contact person or address is readily available.

8. **Add the total number of points you awarded** to this site and determine your overall WWW Cyberguide rating. For any specific category that did not apply to this site, deduct five points from the total possible points.

- ____ (100-91 points) - This site is so well-designed, and so effectively meets my instructional goals, that I can provide my students with general instructions and allow free exploration.
- ____ (90-76 points) - This site contains good material but a site map with specific directions will assist my students in reaching the stated objectives.
- ____ (75-61 points) This site contains information that will make stops at designated points worthwhile, but students will need more structured guidance to reach my instructional goals. A list of bookmarks to specific pages and/or links is advisable, as is frequent discussion of student progress.
- ____ (60-46 points) Although useful information exists at this site, its most effective contribution to my objectives will be in whole-class instruction where I can guide exploration and keep students on task.
- ____ (45-31 points) This site contains a few pieces of information that make it a possible alternative when other sources are not readily available. Supervised student use is advised.

Critical Evaluation of a Web Site: Secondary School Level

http://www.capecod.net/schrockguide

©1996 Kathleen Schrock (kschrock@capecod.net)

Note: I've taken the liberty to delete minor segments of this form.

URL of Web page you are evaluating :

http://_____

Name of the Web page you are evaluating : _____

Technical and Visual Aspects of the Web Page

Does the page take a long time to load? YES / NO

Do the pictures add to the page? YES / NO / NOT APPLICABLE

Is the spelling correct on the page? YES / NO

Are there headings and subheadings on the page? YES / NO
If so, are they helpful? YES / NO

Is the page signed by the author? YES / NO

Is the author's e-mail address included? YES / NO

Is there a date of last update? YES / NO
If so, is the date current? YES / NO

Is the format standard and readable with your browser? YES / NO

Is there an image map (large clickable graphic w/ hyperlinks) on the page? YES / NO

Is there a table on the page? (You may have to look at the source code) YES / NO
If so, is the table readable with your browser? YES / NO

If you have graphics turned off, is there a text alternate to the images? YES / NO

On supporting pages, is there a link back to the home page? YES / NO

Are the links clearly visible and explanatory? YES / NO

Is there a picture or a sound included?
If so, can you be sure that a picture or sound has not been edited? YES / NO
If you're not sure, should you accept the information as valid? YES / NO

Content

Is the title of the page indicative of the content? YES / NO

Is the purpose of the page indicated on the home page? YES / NO

When was the document created? _____

Is the information useful for your purpose? YES / NO

Would it have been easier to get the information somewhere else? YES / NO

Would information somewhere else have been different? YES / NO
If so, why?_____

Did the information lead you to other sources that were useful? YES / NO

Is a bibliography of print sources included? YES / NO

Is the information current? YES / NO

Does up-to-date information matter for your purpose? YES / NO

Does the information appear biased? YES / NO

Does the information contradict something you found somewhere else? YES / NO

Do most of the pictures supplement the content of page? YES / NO / NOT APPLICABLE

Authority

Who created the page? _____

What organization is the person affiliated with?_____

Has the site been reviewed by an online reviewing agency? YES / NO

Does the domain (i.e. edu, com, gov) of the page influence your evaluation? YES / NO

Are you positive that the information is true? YES / NO

What can you do to prove that it is true?_____

Are you satisfied that the information is useful for your purpose? YES / NO
If not, what can you do next?

Can you get a printed version of the information? YES / NO

Narrative Evaluation

Looking at all of the data you have collected above while evaluating the site, explain why or why not this site is (or is not) valid for your purpose. Include the aspects of technical content, authenticity, authority, bias, and subject content.

_____

_____

_____

_____

Carol Caruso

Before You Cite a Site

For uncritical users, the World Wide Web can be a tangle of misinformation. A teacher offers tips to help educators and students to gain insight on the validity of Web sites.

One of my 7th graders was so excited when he got his first computer that he spent much of his time on it. His love of technology led him to the Internet, and he soon built his own Web site. His site is now among the millions of sites on the Internet, and if you search for a site on computer repair and network consultation, you may have to wait for his services—because he needs to be home in time for dinner.

I admire my student's spunk and ingenuity. If I were searching the Internet for a consultant to network my business, however, I would want to know that this entrepreneur is an ambitious 12-year-old. With this, and many other well-developed sites just a mouse click away, how can we determine the correctness of the information we see? More important, how can we teach children to determine the validity of these Internet-based resources?

Students must learn that many reputable sites and many unreliable sites reside side by side.

The Internet, by design, supports freedom of speech. It is a work in progress, and anyone is free to publish information or an opinion on it. There are no editors, and no cyberpolice to steer us away from the unreliable sites (although there is quite a bit of software available now to help us filter out the distasteful sites).

Enter Goals 2000. This push for information technology in our K–12 schools encourages us to weave this information-rich medium into our curriculum. Educators can easily see applications for its use with science and history fairs, literature-based instruction, and information gathering for classroom debates. Most K–12 schools have access to dial-up accounts. Some have more sophisticated access to the Internet. Training is available, but mainly in the form of showing educators the benefits of this information source. Assuming we know how and why to navigate the Internet, have access, and feel the push of Goals 2000, what next?

The Four Ws of Site Validation

Sorting the fluff from the substance is a necessary evil for any teacher or student who decides to use the Internet for research. What are some of the things we can teach our teachers and students to look for in a Web site to determine if the information it contains is valid? This brings us to the who, what, when, and where of site validation.

Who wrote the site? Is the author of the site qualified to voice his or her viewpoints about the subject matter? Are the author's credentials mentioned? Is the site sponsored or co-sponsored by an individual or group? If so, have you heard of the group before? Is contact information for the author included in the Web site? An e-mail message to the webmaster can get you the information you need if it is not readily available. Don't be afraid to ask for it. Looking to see who is talking is the first and probably the most important step in site validation. If you can't find an author or webmaster, look for another site. There is plenty of information out there.

What are they saying on the site? What links are on the page and how reliable are they? What is the scope of the topic? Is the information too broad, too shallow, or just the right depth? Do you think the information is factual? Do you suspect any author bias? A gut feeling is probably enough to send you surfing. Is the information you need free, or is it linked to a part that requires access fees? Is what you need to see easy to download, or are the graphics so extensive that the content of the site is lost in download time? Is the text well written? Is what you see worth a bookmark? Is the content age-appropriate? Has the site received any awards? Is the information short enough to be printed out? The content of the site, of course, is only one piece of information. Educators must make certain that learners don't rely solely on Web resources and ignore information available in books, videos, and human resources.

When was the site created? When was it last revised? If the creation date is not posted directly on the site, you can sometimes determine how current it is by clicking on its links. If the links don't work, the site has probably not been updated in a while. The importance

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of knowing the timeliness of information on a site will vary based on your research needs. Up-to-date information will be important if you are researching an event in progress, but less critical if you are writing a history report on the life and times of Abraham Lincoln. An e-mail message to the author or webmaster can also help you determine how current the information on the site is.

Where is the site from? Where did it originate? Is it buried in someone's Internet account (http://www.monmouth.com/user_pages/malim/) or does it have its own domain name (http://www.rutgers.edu)? Is the domain name reputable? What server houses the site—and why? Is it a paid service provider or part of an organization? What does the URL tell you about the site? Does the URL indicate that this site is an educational institution (.edu) or government (.gov)? If it is a commercial site (.com), is it a source you can trust? If you just did a search and landed on a site with a long URL (http://web.wn.net/%7Eusr/ncter/web/valid.html), what happens when you trace it back to its parent directory (http://web.wn.net)? Many genre categories exist as sources for Internet sites including universities, commercial services, electronic journals and commercial magazines, special interest groups, companies and organizations, advertising pages, personal pages, search engines, software sites, city and state pages, federal government pages, and special interest groups.

InterNic is also a valuable resource for determining the origins of the information you find. Established in January 1993 as a collaborative project among AT&T, General Atomics, and Network Solutions, Inc., this resource allowed me to search a database and learn the originator's name and the host server of a site. To use this part of the service, visit http://rs1.internic.net/cgi-bin/whois.

Toward Critical Use

Making the Internet available in K–12 schools is not enough. We need to teach children about the vastness of the information available to them. They must learn that many reputable sites and many unreliable sites reside side by side. Equal access is available, and this unbiased medium will voice the opinions of Ivy League professors, as well as your next-door neighbors. I encourage you to visit some of the sites on the Internet that have posted site validation checklists, including *Kathy Schrock's Guide for Educators: Critical Evaluation Surveys* (http://www.capecod.net/schrockguide/eval.htm), *Evaluating Internet Resources: A Checklist* (http://infopeople.berkeley.edu:8000/bkmk/select.html), and *How to Critically Analyze Information Sources* (http://urisref.library.cornell.edu/skill26.htm). Adapt these instruments to your district's research needs, and teach the teachers and students how to use them before they take what they see on the Internet as truth and use it to prove a point.

By the way, my 7th grader's computer repair and network consultation site is pretty nice—and his rates are competitive. ■

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Sorting the fluff from the substance is a necessary evil for any teacher or student who decides to use the Internet for research.

Carol Caruso is Teacher/Technology Coordinator at Knollwood School, 224 Hance Rd., Fair Haven, NJ 07704 (e-mail: ccaruso@monmouth.com).

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Rubric for Assessing Student-Developed Web Pages

Criteria	Standards				
	Level 1	Level 2	Level 3	Level 4	Level 5
Development Process	Handwritten proposal sheet submitted to teacher	Text for page entered into simple word processor or HTML-creation program (BBEdit, PageMill, Claris HomePage, FrontPage)	Draft page is printed out from within Netscape; text on page partially achieves proposal	Evidence of revision of page in web browser (Netscape, Explorer); substantially achieves (or explains changes to) proposal	Critical reflection of development process is submitted in writing (individually)
Network Skill	Student has problems bring up their Web Page within a web browser (Netscape, Explorer)	Text is in a program other than the word processor; images not saved in .gif or .jpg format; One or more files in wrong location or have wrong file name	All .html files in simple word-processor of HTML-creation program; All images .gif or .jpg; All file names and group numbers correct	Running word-processor or HTML-creation program and web browser (Netscape or Explorer) simultaneously; efficient use of Internet access programs	Efficient revision: testing changes by switching between word-processor or HTML-creation program and web browser (Netscape or Explorer)
Thinking Process	Disconnected and unrelated thoughts; vague ideas	Concrete description and evaluation; no analysis of causes, no meaning	Description, analysis, meaning, evaluation; identifies problems and solution	Integrates multiple sources of information to assess issue; balances personal and external	Identifies and examines root causes as well as immediate issue; persuasive and convicted
Writing Process	Difficult to understand, tangents, spelling and other errors	Many errors but consistent line of thought	Easy to understand; perfect spelling; one or two grammar, syntax, or semantic problems	Same as Level 3 but no errors	Clear, concise, well written
HTML Skill	No HTML formatting tags; Text is not broken into paragraphs	Text is broken in paragraphs; Headings are used; no other tags	Paragraphs; headings; title ; and the following tags as appropriate: preformatted text ; styles ; centered text ; horiz. rule	Same as Level 3 plus: images > and links	Same as Level 4 plus at least two lists, Images as Links, "Return to..." links, colored text/background, background image
Layout	Layout has no structure or organization	Text broken into paragraphs and/or sections	Headings label sections and create hierarchy; some consistency	Hierarchy closely follows meaning; Headings and styles are consistent within pages; Text, images, and links flow together	Consistent format extends page-to-page; design is intentional; attention to different browsers and monitor size

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Layout	Layout has no structure or organization	Text broken into paragraphs and/or sections	Headings label sections and create hierarchy; some consistency	Hierarchy closely follows meaning; Headings and styles are consistent within pages; Text, images, and links flow together	Consistent format extends page-to-page; design is intentional; attention to different browsers and monitor size

Navigation	One Page	One Page with TITLE, Heading	2 pages (or one page with links to other resources)	3 pages with clear order, labeling and navigation between pages; all links work	Title Page with other pages branching off, and at least four pages total; Navigation path is clear and logical, all links work
Images	No images	Images are unrelated to page/text/proposal; most images were recycled from other pages on the Internet; Images too big/small in size or resolution; Images poorly cropped or have color problems	Images have strong relation to text; some images are student produced; Images have proper size, resolution, colors, and cropping	Same as Level 3 plus images are from 3 or more sources (scan, CD-ROM, QuickCam, ZapShot, video tape, net, SuperPaint, PhotoShop, LogoMotion, etc.)	Same as Level 4 with either: more advanced Photoshop, PhotoDeluxe or Illustrator work

Source: This Rubric is a modified version of that created by John Pilgrim, SW Computer Electives, Fall 1995, Horace Mann MS.

You can find the original version at: http://www.sfusd.k12.ca.us/schwww/sch618/webschool/authoring/Web_Rubric.html

virtual conferences

As incredible as our access to the Internet is, its classroom use has so far been limited to asynchronous communication. A still-developing technology—virtual conferencing—holds the promise of synchronous two-way communication. Once developed, this new form of communication could allow genuine, real-time connections between teachers and classrooms divided by a continent or even half a world. The authors of this month's column describe their own recent experiences with conferencing applications, and discuss what these programs hold for the future.

By Glen Bull, Gina Bull, Joe Garofalo, and Tim Sigmon

The majority of our past columns have discussed *asynchronous* Internet applications. E-mail is an example of an asynchronous application. The writer posts the mail at one time, and the recipient then reads the mail when convenient. In contrast, the telephone is an example of a *synchronous* communication tool. Both parties must be present at the same time to hold a conversation.

The educational benefits of asynchronous communication are apparent. It is not necessary to schedule class time in advance. For example, a class can access a Web page when it best fits the academic schedule of the course. In synchronous communications, the schedule of the other party also becomes a factor. However, several applications are now available that support real-time interactions over the Internet.

Table 1 describes various forms of virtual conferencing and what they provide users. NetMeeting, Microsoft Corporation's electronic-conferencing application, includes all of the applications listed in this table. The product has been highly rated, and the price is right. As of press time, NetMeeting could be downloaded for free from http://microsoft.com/netmeeting/.

Table 1. Virtual Conferencing Applications

Application	*Description*
Chat	Text alternative to audio
Audio	Internet telephony
Video	Real-time digitized video
Electronic whiteboard	Shared drawing and text
Application sharing	Shared applications, such as word processing or slide presentations
File transfer	Files transferred from one participant to another

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An Overview of Electronic Conferencing

Chat: Text-Based Interactions. In the early 1980s, the World Logo Conference hosted one of the first uses of synchronous Internet communications for virtual conferencing that we recall. A chat mode allowed well-known Logo experts such as Seymour Papert to interact online with participants at dozens of sites around the world. This synchronous interaction had some interesting elements. For example, it was fun to watch teachers from other countries join the conference as the earth turned and the sun came up in their areas of the world.

However, it was soon apparent that online typing is an especially slow way to communicate. Although some readers might type as fast as 200 to 300 words per minute, the average typist manages just 20 to 30. As a result, a participant could leave the local conference room, get a cup of coffee, and return several minutes later without missing much.

Audio- and Videoconferencing. In the early years of the Internet, limited bandwidth and processing cycles prevented real-time video and audio transmission. More recently, the CU-SeeMe application, combined with new and inexpensive video cameras, has popularized real-time video transmission over the Internet. This has been followed by the incorporation of real-time video and audio transmission in many other Internet applications.

The quality of these early implementations has often been uneven. Images in video transmissions sometimes appear as if they were moving underwater, and audio may sometimes be less clear than a telephone transmission. To understand why this is so, we must consider two factors: (1) the Internet as a system and (2) variations in its bandwidth.

First, the Internet is a system that was designed to transmit digital rather than analog data. Because video and audio signals are analog, they must be digitized and broken into separate packets of information before they can be transmitted. Sometimes, all of the packets do not arrive at their destination in a timely fashion or in the correct sequential order.

The result is roughly equivalent to tearing a letter into small pieces and sending each piece in a separate envelope. The recipient must then open each envelope and tape the pieces together. The envelopes in this example roughly correspond to Internet packets, while the contents correspond to pieces of the video or audio signal.

Second, the Internet's bandwidth—its *information-carrying capacity*—varies by time of day and location of both sender and receiver. In an asynchronous application, it does not matter if some packets do not arrive instantaneously. For example, if you access a Web page that has a video clip, your browser simply waits until all packets arrive and are assembled before it displays the video. In a synchronous application such as videoconferencing, however, video frames may simply be discarded if the bandwidth is not broad enough. Television is normally displayed at a rate of 30 frames per second, so at lower frame rates, a video image can appear jerky and uneven like in an early moving picture.

For some instructional uses, a grainy and flickering image may be good enough. In a project sponsored by the National Science Foundation several years ago, for example, April Lloyd (then a teacher in Charlottesville, Virginia) became one of the first people to participate in a live broadcast from the South Pole. In addition to an analog transmission, a digitized video signal was sent over the Internet. April's third-grade class was riveted to this less-than-perfect image on the computer screen. The moment's historic importance more than compensated for minor technical glitches.

Electronic Whiteboards. The electronic whiteboard is another synchronous Internet application. The idea behind it is simple: A teacher on the U.S. East Coast, for example, uses a mouse to draw or write on his or her screen, and a replica of everything written or drawn appears on a screen in another classroom on the West Coast.

In certain respects, electronic whiteboards place fewer demands on the Internet than do the synchronous transmission of audio or video data. Uncompressed audio might involve the transmission or transfer of several thousand bits per second; the rates for video are orders of magnitude higher. In contrast, only the pixels drawn on the whiteboard must be transmitted; this might mean transmission of a few hundred bits per second rather than thousands or millions.

Different styles of electronic whiteboards come in a variety of price ranges. For example, a whiteboard on a computer screen does not entail any additional hardware cost. This technology, when combined with conferencing software such as NetMeeting, can allow viewers at distant locations to view everything drawn on a local computer screen.

Because a mouse is not easy to manipulate for certain types of diagrams and illustrations, a graphics tablet with a stylus is a useful accessory. A *physical electronic whiteboard* linked to the computer is just an extension of this concept. This particular whiteboard looks like an ordinary whiteboard, but anything marked on it is also drawn on the screen of an attached computer. In turn, the local computer's display can be echoed to a remote location for many, but not all, such systems. Some systems of this kind may cost as little as $1,000, which makes them affordable for many schools. Larger versions with more features cost more, of course.

More sophisticated *projected whiteboards* allow a computer projection system to display the computer image on the whiteboard. By combining the two technologies this way, a teacher will appear to be writing on top of the computer screen. This device can be used by a teacher locally or transmitted to a remote location as well.

There are two types of projectable electronic whiteboards. *Front-projection* systems are less expensive and often use existing

liquid crystal display (LCD) computer-projection panels. One drawback of these systems is that a presenter may block the projected light if he or she stands between the projection system and the whiteboard.

A *rear-projection* system solves this problem by allowing a presenter to stand anywhere he or she wants without blocking the projector. These systems often have enough brightness in the projected image to allow their use with room lights on. However, the case enclosing the projection system can be bulky, cumbersome, and hard to move from one location to another.

A rear-projection electronic whiteboard contains several expensive elements: a multimedia computer, a projection system, lenses and mirrors that must be adjusted to focus the image, and an enclosing cabinet. Still, it is the closest approximation yet to an electronic version of a chalkboard. It allows a teacher to work in a natural way—facing a class with the room lights on. Table 2 gives a synopsis of each type of whiteboard and its advantages and limitations.

Application Sharing. Another function—application sharing—is often incorporated into virtual-conferencing systems. When we wrote this column, for example, we worked from two different locations—one of us in the computing center and the other in the school of education. Both of us could see the same text as we worked. NetMeeting's application-sharing function allows each of us to share a word-processing program and jointly edit the document. In this way a change made by one person is shown on both screens.

The same application-sharing function can be used for any application program. For example, a slide-show presentation on a computer in one location can be controlled by a speaker at another. This will allow a guest speaker to control a slide-show presentation in your classroom from a half-continent away. Ideally, the slide show itself would reside on a local computer in the same room as the class or audience to avoid having to transmit bandwidth-intensive pictures over the Internet. Only the relatively low-bandwidth signals that advance the next slide need to be transmitted.

File Transfer. Virtual-conferencing systems also sometimes include electronic file-exchange functions. This is somewhat different from application sharing, in which a file in one location is shared by users in two locations. In file exchange, an actual copy of a file is transferred from one location to another. The file transfer protocol (FTP) was one of the first protocols devised for the Internet, and virtual-conferencing systems provide this function in a convenient and easily used format.

A Virtual Presentation at the ISTE Technology Leadership Workshop

Last summer at NECC '97, we had an opportunity to try out the virtual-conferencing functions described above. During the ISTE Technology Leadership workshop we used a Xerox-developed rear-projection electronic whiteboard, "Liveboard," at two sites—one at the conference in Seattle and a second at the University of Virginia in Charlottesville.

The experience was interesting but instructive. We used electronic-whiteboard capabilities, a live video link, application sharing, a graphing calculator linked to the display, Xerox's MeetingBoard software, and Microsoft's NetMeeting. On that particular day, 12 Internet routers relayed our data between the two locations. (We used a UNIX "traceroute" application to monitor the connection.) All went well during the first half of the presentation, but then a router between Seattle and Virginia stopped transferring packets. Asynchronous applications such as e-mail are not limited by this sort of problem: Messages are simply held for retransmission until a router has been reset.

In this case, the presentation came to a screeching halt. Audiences do not wait as patiently as stored e-mail messages do (and should not be expected to). Fortunately, we had half-jokingly arranged with Bob Tinker to amuse our audience with song and dance in the event of a glitch. Bob is better known for inventing such concepts as microcomputer-based laboratories (MBLs), but, to our delight, he demonstrated that he is also quite versatile. Thanks, Bob!

ISDN Connections. When the router was restored several minutes later, the Internet path that returned did not have sufficient bandwidth to allow transmission of a synchronous video signal. The bandwidth available on a given Internet path depends on several factors, including what other users may be doing at any particular time.

For this reason, corporations that rely on videoconferences often use dedicated *integrated services digital network* (ISDN) circuits rather than the Internet. These circuits are fairly expensive and somewhat complex to set up because they involve several

Table 2. Types of Electronic Whiteboards

Type	*Advantage*	*Limitation*
Computer display	No additional cost	Mouse-based drawing
Graphics tablet	Uses stylus	Not designed for whole-class use
Electronic whiteboard	Closely resembles conventional chalk board	Separates whiteboard and computer display
Front-projection system	Combines whiteboard and computer display	Presenter cannot stand between projector and screen
Rear-projection system	Presenter's location not critical	Expensive

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different standards, including those used by the phone company, the message sender's equipment, the receiver's equipment, and so on. For this reason, many engineers swear that ISDN stands for "I Still Don't Know." However, once established, it is a consistent and reliable connection with known bandwidth.

The Virtues of POTS. We were able to hear a bit of what was going on in Seattle even when the Internet connection failed because we had arranged for a telephone link—sometimes called POTS for "plain old telephone service"—in addition to the Internet connection. We chose to use a telephone link rather than digitized audio transmitted over the Internet to ensure a high-quality audio signal. The telephone link gave us the three most desirable qualities for an audio link for a virtual conference. An audio signal should be (1) intelligible, (2) full-duplex, and (3) synchronous.

Intelligible simply means that speech can be clearly understood. This is a function of many factors, including the transmission channel's bandwidth, the transmitted language's statistical and predictive properties, and human neurophysiology. More than a century of research by institutes such as Bell Labs (which has had more than its share of Nobel laureates) has been devoted to development of the existing analog phone system to ensure that speech is intelligible. This is not the case for the audio quality of speech transmitted over the Internet, if only because the bandwidth available depends on many external variables.

A *full-duplex* signal permits both parties to talk and hear at the same time. In contrast, a half-duplex system permits only one party to speak at a time. This leads to an awkward and stilted form of communication. A related problem is that ambient room noise can sometimes be mistaken for speech by the electronics of a half-duplex speakerphone, especially when a large audience is present.

The term *synchronous* means that the speech is heard at the same time it is spoken. In an article in the October 1945 issue of *Wireless World*, noted science-fiction writer Arthur C. Clarke predicted that communication satellites in geostationary orbit would allow the development of a global communication system. He predicted that this system would replace copper wires and land lines.

Corporations such as ComSat did place communication satellites into what became known as the "Clarke Belt," a geostationary orbit 22,300 miles above the equator. These satellites are used to transmit television broadcasts, but they did not replace earth-based telephone wiring and networks. Clarke had overlooked one factor—the speed of light! The signal's round trip from earth to the satellite and back resulted in a slight but perceptible lag. Telephone users found this lag unacceptable.

This is another example of engineering specifications colliding with human physiology. Designers may sometimes wish that humans would be more "flexible" when the quality of a system is less than desirable. Human communication systems, however, evolved over many millennia. Designers ignore this at their peril.

For all of these reasons, we had requested an analog phone with a full-duplex speakerphone for the conference. This not only improved the quality of the audio that was available for the presentation (it was better than an audio signal transmitted over the Internet), but also provided us with a redundant communication channel to coordinate bringing the system back up after it went down. It is a remarkable fact that as the world enters the 21st century, most classrooms and teachers will still not have easy access to the telephone—a communication technology invented in the 19th century.

Summary

Even with the glitches we had during our presentation, we found the experience useful. The small, grainy, low-bandwidth images associated with today's digital conferencing systems are much like the first silent, flickering films of early movies. Recent video compression and streaming applications such as Real Video (developed by Progressive Networks; http://www.real.com) are promising developments. This technology allows viewers, for example, to watch live C-SPAN broadcasts (http://www.c-span.org) of congressional hearings over the Internet. These technologies are useful for live broadcasts and interactions, as well as for archived video that can be accessed asynchronously.

Today's digital virtual-conferencing systems have many limitations. They are still in their infancy. Even so, they allow experimentation at any price level, even in today's classrooms. Microsoft, for example, has made NetMeeting available at no charge. A computer with an Internet connection is all a class needs to begin exploration. NetMeeting's whiteboard, application sharing, and file-exchange features can be used with computers straight out of the box. Adding a sound card and microphone can let anyone experiment with audioconferencing, and an inexpensive video camera allows videoconferencing. At some point in the future, teachers will routinely stand before a flat-screen, high-resolution electronic whiteboard connected to the world.

We want to hear about your use of digital conferencing systems in your own classroom. Do any "Mining the Internet" readers routinely use these technologies in their classrooms? We want to revisit this technology next year and feature classroom applications of the technology in its current state. ■

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Simple Start

Pedagogical Resources

This collection of pedagogical links is just a sampling of the available resources on the topic of pedagogy and networked instructional technology. We have chosen sites that we think will be especially useful to UNC faculty and instructors.

Theory | Practical Tips and Planning | Evaluation

Theory

Delivering Instruction on the World Wide Web
By Thomas Fox McManus, University of Texas at Austin
http://www.edb.utexas.edu/coe/depts/ci/it/projects/wbi/wbi.html

Discusses advantages and disadvantages of using the Web in teaching. Includes some introductory material (basic terminology, HTML). Applies contructivist and objectivist theories to Web-based instruction. Includes a link to McManus's Special Considerations for Designing Internet Based Instruction.

.plorations in Learning & Instruction: The Theory Into Practice Database
By Greg Kearsley, George Washington University
http://www.gwu.edu/~tip/

A useful guide to over 50 theories of instruction. For each theory, provides a summary, a bibliography, and the names associated with it. Database searchable by theory, domain, and concept.

The World Wide Web in Education: A Closer Look
By Andy Carvin, of Ed Web
http://k12.cnidr.org:90/web.intro.html

Essay which attempts to answer the question, "What exactly does the World-Wide Web have to offer education?" Discusses the role of the Web in curricular reform, the importance of hypertext, and the Web's future in the classroom.

Practical Tips and Planning

Encouraging Students to Use Technology
Robert Harris, Southern California College
http://www.sccu.edu/faculty/R_Harris/techuse.htm

Offers twelve practical and simple tips for higher education educators interested in incorporating technology into the classroom.

.signing Learning Environments in Cyberspace
By Rory McGreal et al,TeleEducation New Brunswick

http://cnet.unb.ca/clrn/nb/c/leafs/learning_on_the_web/page042.html

Sixth module in a series entitled Learning on the Web: An Instructor's Manual, addresses testing, pacing, design, and course objectives. Offers 18 tried-and-true ctivities (or lessons) for promoting learning and accomplishing specific objectives.

Some Thoughts about Web Quests
Bernie Dodge, San Diego State University
http://edweb.sdsu.edu/courses/edtec596/about_webquests.html

Explanation and examples of WebQuests, inquiry-oriented activities in which some or all of the information that learners interact with comes from resources on the internet.

WWW Constructivist Project Design Guide
Institute for Learning Technologies, Coulmbia University
http://www.ilt.columbia.edu/k12/livetext/curricula/general/webcurr.html

This guide to designing constructive, cooperative learning projects on the Web includes sections on preparation, student surfing, concept formation, and research. Each section containg links to many other resources.

Evaluation

Criteria for Evaluation of Internet Information Resources
Department of Library and Information Studies, Victoria University of Wellington
http://www.vuw.ac.nz/dlis/courses/847/m2resevl.html

A list of questions and topics to consider when evaluating Web information sources.

Evaluating Internet Based Information
Don Descy, Mankato State University
http://www.lme.mankato.msus.edu/class/629/cred.html

Resource for a course on 'Internet and the School.' Links to various Web sites which promote discussion of credibility and quality. Also includes links to relevant readings and a list of questions for Web site evaluation.

Evaluating Internet Research Sources
By Robert Harris, Southern California College
http://www.sccu.edu/faculty/R_Harris/evalu8it.htm

Useful for students and instructors. Presents basic techniques for evaluating Web pages. Explains what to look for and what to avoid, how to recognize credible sources.

Evaluation Tools
Multmedia in Manufacturing Education
http://mime1.marc.gatech.edu/MM_Tools/evaluation.html

A collection of ten tools for evaluating interactive learning systems. Tools include interview protocol, questionnaire, user interface rating form, focus group protocol and formative review log.

Impact of Interactive Media
Bill Orr, Auburn University
http://tenb.mta.ca/asigdiff.html

A collection of research articles that show that the use of interactive media has a positive impact on learning outcomes.

No Significant Difference
Thomas Russell, North Carolina State University
http://tenb.mta.ca/phenom/

A collection of research articles, written over a thirty-year period, which show that the technology used in instruction has no impact on learning outcomes.

Sloan Center for Asynchronous Learning Environments
University of Illinois at Urbana-Champaign
http://w3.scale.uiuc.edu/scale/

Links to the Center's evaluations of asynchronous learning projects during three consecutive semesters. Includes surveys and interviews with students, staff, and faculty. Also includes a section on "Gains in Student Achievement."

Thinking Critically about World Wide Web Resources
Esther Grassian, UCLA College Library
http://www.library.ucla.edu/libraries/college/instruct/critical.htm

Provides a list of questions for use in evaluating Web sites.

To the Simple Start Main Page

Maintained by: Simple Start
URL: http://www.unc.edu/courses/ssp/ped.html
Reviewed: 7 April 1997

Live Text INSTITUTE FOR LEARNING TECHNOLOGIES
Teachers College Columbia University

Readings Groups Sections

Technology Pedagogy	
Cognition	Community Networks
Constructivist Inquiry	Hypertext
Learning Styles	Media Literacy
School & Community	Simulations
Technology Pedagogy	Telecom. Project Design

Technology and Reform Policy	
Columbia Sources	Copyright
Censorship	General Reform
Learning Organizations	Pedagogy Reform
Small Schools	Staff Development
Technology Policy: K12	Telecomm. Policy
Essential and Small School Technology Projects	

Readings Group Main Page:

Technology & Pedagogy

These readings (essays and white papers) concern the roles networked digital communication and multimedia can play in enabling effective educational practice and reform of the public schools. The first section contains readings on teaching with technology; the second on technology and school reform policy. For more on **Technology Planning**, **Technology Curricula**, or **Media Studies**, visit those pages. See also Online Text for online information sources other than essays, including listservs and bulletin boards.

Power and Pedagogy (1992) is a comprehensive and pointed look at the opportunities, pitfalls and implications for change implied by new learning technologies, by Robert McClintock, director of ILT. Institute for Learning Technologies: Pedagogy for the 21st Century is a summary white paper on technology and school reform, with a hypertext bibliography to topics in Essential School Reform, School Size, Constructivism, Professional Development, Participatory Design, Situated Action and other ILT documents.

Cognition, Computer-Mediated Communication & Learning Styles

ACT Research Home Page
(John Anderson, Carnegie Mellon) Concerned with the ACT theory and architecture of cognition, including problem solving, memory, and skills acquisition. Online papers on various topics occur at the bottom of ACT Selected Publication.

Basic Multiple Intelligence Theory

(Howard Gardner, EdWeb) Recent advances in cognitive science, developmental psychology and neuroscience suggest that each person's level of intelligence, as it has been traditionally considered, is actually made up of autonomous faculties that can work individually or in concert with other faculties. Howard Gardner has identified seven such faculties, which he labels as "intelligences".

Howard Gardner Topics

New Link (Penn State College of Ed.) The father of "multiple intelligence theory" and mentor to the Coalition of Essential Schools on various topics, including: Description of Multiple Intelligence Theory; Why Changing Schools is Difficult; Advances in Learning Theory, Portfolio Assessment, Being Educated (in the year 2010); The Need for a National Spokesperson, and other topics. A must-read.

Learning Styles Readings

(St. Johns Unversity) Readings and newsletters on Learning Style Theory.

Situated Cognition and the Culture of Learning

(John Seely Brown, Allan Collins and Paul Duguid) Different ideas of what is appropriate learning activity produce very different results. Activity and situations are integral to cognition and learning.

Learning & Instruction: The TIP Database

(Greg Kearsley, George Washington State) TIP is a tool intended to make learning and instructional theory more accessible to educators. The database contains brief summarizes of 50 major theories of learning and instruction. These theories can also be accessed by learning domains and concepts.

NetFuture

New Link (Steven Talbott) A newsletter concerning technology and human responsibility for the future which "seeks especially to address those deep levels at which we half-consciously shape technology and are shaped by it."

Social and Psychological Effects in Computer-Mediated Communication

New Link (M.A. Boudourides: Democritus University of Thrace, Greece, 1995) An excellent overview, identifying key issues, with a hypertext bibliography.

Visual Literacy

(Pomona College) A hypertext primer on the terms and elements of visual literacy, the "basic skills" approach for visual learning.

Community Networks

Why Community Networks?

(Colorado University) A page of readings dedicated to evidence of the value of virtual educational communities.

Public Spaces on the Information Highway: The Role of Community Networks

New Link (Thesis, Andrew Avis, U Calgary) "Through two case studies, an analysis of three potential benefits arising from community networking is developed. These three benefits are: increased participation in the democratic system, increased access to education, and community development. Several models for providing universal access, through community networks, are presented."

New Community Networks: Wired For Change!

New Link (Morino Institute) How to set them up. "Community networks are computer systems that are designed for community use. They are not "on-ramps" to the "information superhighway." Community networks are generally free to use,although some systems have established fees for some services."

Communities Online: Community-Based Computer Networks

New Link (Thesis, Anne Beamish, MIT) "Most community networks are rich in local information, ranging from job opportunities to minutes of the city council meetings. But, surprisingly, in spite of the intention to increase a sense of community and democratic participation, many community networks provide limited opportunity for public debate and discussion."

Constructivist Inquiry

Democracy and Education

(John Dewey) The classic work, presented in hypertext form. In a sense, Dewey was the first to bring

constructivism (a.k.a. instrumentalism) to pedagogic discourse.

Technology and Education: New Wine in New Bottles -- Choosing Pasts and Imagining Educational Futures
(Robert McClintock, Luyen Chou, Frank Moretti and Don H. Nix: NLTL, 1993) Constructivist Pedagogy and school design discussed in light of post-print information technologies.

Creating a Cumulative Curriculum
(NLTL, 1991) An overview of the Dalton Technology Plan.

Archaeotype
(Brown, Chou, Goldberg, Moretti, NLTL: 1991) A description of a networked multimedia enabling constructivist curriculum.

Constructivism, Technology, and the Future of Classroom Learning
(Strommen, Lincoln: CTW, 1992). A framework for educational reform, addressing the estrangement of students from print and the potential for new pedagogy and classroom practices through multimedia technology.

Grazing the Net: Raising a Generation of Free Range Students
Jamie (McKenzie, *From Now On*) A discussion of constructivism and the Inquiry approach using the Internet in the Classroom. From Now On is an educational journal devoted to technology-related issues.

Mining the Internet
(Judi Harris, UIUC) The renowned collection of articles on student use of Internet resources, originally published in "The Computing Teacher".

Problem-Based Learning
(Exploring The Environment Instructor Notes, Wheeling Jesuit College) Outlining a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems

Virtual Museums and Student Curators
(Jamie McKenzie, From Now On, Jan, '96) The World Wide Web makes possible a powerful new kind of student-centered, constructivist learning by collecting at a single site a phenomenal array of learning resources that can be explored with simple point-and-click skills.

WebQuests Pedagogy
Description of inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the internet, optionally supplemented with videoconferencing.

Hypertext

An Internet Full-Text Miscellany
New Link (Keith Ewing, St. Cloud State) "An idiosyncratic bibliography of links to documents and articles on the development and impact of the Internet, with special reference to the hypertext and computer mediated communication."

As We May Think
(The Atlantic Monthly, July 1945) by Vannevar Bush, a former Massachusetts Institute of Technology president and Director of the Wartime Office of Scientific Research and Development. One of the first visions of a hypertext information environment.

Ed Psy 387: Computer Uses in Education
(UIUC) A collection of resources used in a course focused on the joint construction of a hypertext document. This page is a work-in-progress of the course.

Things to Put in Your Head
(IATH, Virginia) An extensive online bibliography of readings from The Theory and Practice of Hypertext.

The World Wide Web in Education:
(Andy Carvin, EdWeb, CNIDR) What exactly does the World-Wide Web have to offer education? This website,will attempt to articulate some possible answers. You can begin by choosing from any of the following sections: The History of the Web, The Importance of Hypertext, The Web as an Educational Tool, and The Web's Future in the Classroom.

Media Literacy

Aether Madness: An Offbeat Guide to the Online World

New Link (Gary Wolf and Michael Stein) The Web version of this cyberspace tourbook. Somewhat out-of-date but useful for web newbies.

City of Bits

New Link (William J. Mitchell, MIT) "A comprehensive introduction to a new type of city, a largely invisible but increasingly important system of virtual spaces interconnected by the emerging information superhighway."

Critical Thinking Library

(Center for Critical Thinking, Sonoma) A page of readings on theory and practice of Critical Thinking pedagogy, including "A Glossary of Critical Thinking Terms", "Socratic Teaching", "Why Students-and Sometimes Teachers-Don't Reason Well", and "Pseudo Critical Thinking in the Educational Establishment".

How to Critically Analyze Information Sources

(Joan Ormondroyd, Michael Engle and Tony Cosgrave, Cornell University Library, 1996) A library research guide, which covers: INITIAL APPRAISAL (Author, Date of Publication, Edition or Revision, Publisher, Title of Journal) and CONTENT ANALYSIS (Intended Audience, Objective Reasoning, Coverage, Writing Style, Evaluative Reviews).

Interactive Multimedia in University Teaching and Learning

(Australia) A thorough if dry article on educational technologies - includes a well-articulated software typography.

Introduction to Etext

New Link (ipacific.net, Australia) "The aim of this site is to address generally the place of etexts in post secondary education, with a practical emphasis. .. Our primary concern is giving an overview of the issues related to etext as well as practical information about how to use etexts."

When the BOOK? When the Net?

(Mckenzie, *From Now On* , Vol 5, No 6 -- February-March, 1995) When is a BOOK the best place to turn? When is the NET the best source? When will a CD-ROM encyclopedia or periodical collection outperform them both?

School/Community Networks and Partnerships

Building School Community Relationships

New Link (Melanie Goldman and Catalina Laserna, BBN National Network Testbed) An excellent paper reflecting on a number of nationally recognized projects. Linked with permission.

Community Cluster Projects

(The Knowledge Project) A compact and clearly articulated posting on the shape and management of community partnerships for educational technology projects. "Community clusters" involve educational institutions, libraries, government agencies, businesses, and at-home users to offer content along with access to new media and information that is appropriate for a specific community.

Creating Networks of Support for Students - 1995

New Link (US DOE) From the monograph, "Raising the Educational Achievement of Secondary School Students," this primer offers guidelines and a summary of promising practices.

Four Seasons Network

New Link (Gary Obermeyer, 1994) "A collaborative investigation of Authentic Assessment by classroom practitioners from Harvard's Project Zero, the Coalition of Essential Schools, Foxfire, and the National Center for Restructuring Education, Schools, and Teaching (NCREST). See also the Four Seasons Model.

K-12/Higher Ed Technology Partnerships

(Institute for Academic Technology, Washington) Compiled by: Carolyn Kotlas, MSLS, Institute for Academic Technology. A catalogue of Web pages from partnerships between colleges and K-12 schools.

Mentoring

New Link (Murray Bergtraum High School, NY) A guide for program developers and participants

"implementing the much ballyhooed, but not yet realized concept of partnership, by examining existing mentoring programs and creating a a resource of mentoring programs for K12 schools world wide. ...We are interested in finding mentoring programs and pointing them out and determining what it takes to have a successful mentoring program in your school or community."

NASA K-12 Internet Initiative: Lessons Learned '94

New Link (Marc Siegel and Steven Hodas, NASA) "This paper is intended for people who are interested in operating online interactive projects which connect working professionals with students and teachers to facilitate learning and exploration.discusses two test projects mounted by NASAs K12 Internet Initiative which connected K12 students and teachers with science and engineering professionals over the Internet."

National Parent Information Network

(UIUC) An effort though the Eric Clearinghouse to support parent involvement and community networking through the Web. Includes a "Parents askERIC" question-answering service.

Organizing educational network interactions: Steps towards a theory of network-based learning environments

New Link (James A. Levin, UIUC, 1995)"This paper takes several sets of recommendations for effective uses of educational networks, synthesizes them into several different frameworks as steps toward a broader theory of network-based learning. This synthesis is evaluated in light of a particular approach to professional development that we have been studying over a number of years."

Strategies for Successful Instructional Partnerships

New Link (Eisenhower National Clearinghouse) "Teacher planning is characterized by different types and styles of planning, the lack of written plans, and reliance on published curriculum materials. ... With the current emphasis on information literacy, lifelong learning, and critical thinking, planning partnerships become paramount. The author describes teacher planning and offers research-based strategies for effective collaborative planning.

Using Technology to Build a Community of Learners

(Janice Abrahams, CNDIR) A page of statistics and hypertext links relating the Education Sector to the NII.

Simulation

Engines for Education: Goal-Based Scenarios

(Roger Schank, Northwestern) Click through this section of this seminal hypertext resource on the reform of educational practice. The Web version of Engines is organized as a network of snippets which are interconnected by the questions they raise. This section outlines and gives examples for design of simulations.

Tommy Lee on Sim City

(SPCWeb, ILT) Bram Moreinis, ILT Coordinator of School-Based Projects, interviews sim-software hotshot Tommy Lee, 10th grader at the School for the Physical City.

Telecommunications Project Design

Keys to a Sucessful Project

(Al Rogers, Kidsphere posting) Want to conduct an exciting collaborative learning project online? Here are some guidelines which may help you organize and advertise your project idea.

How Teachers Find Projects

(Beverly Hunter, BBN) "How do teachers find and join networked projects and virtual communities on topics they are pursuing with their students? How do teachers on the Internet find and join projects relevant to their interests and their students interests? How do they locate groups and projects that are on separate networks like FrEdMail or Iris or AT&T network?

Organizing Electronic Network-Based Instructional Interactions: Successful Strategies and Tactics

(Michael Waugh, James Levin, University of Illinois) The purpose of this paper is to describe some of the common organizational elements which can be employed to enhance the organization of network-based activities, and thus to sketch out some of the strategies and tactics of successful educational networking.

Recent Books and Articles

New Link (Jamie McKenzie, From Now On) McKenzie is well known for his writings and lectures on virtual museums, students as infotectives, parents and computers, and internet censorship.

Telementoring: One researcher's perspective

New Link (Kevin O'Neill, CoVis) An excellent primer on various telementoring structures and their effects, drawn from the Collaborative Visualization project.

||| LiveText => Resources | Readings | Schools | Curricula |||

Live Text

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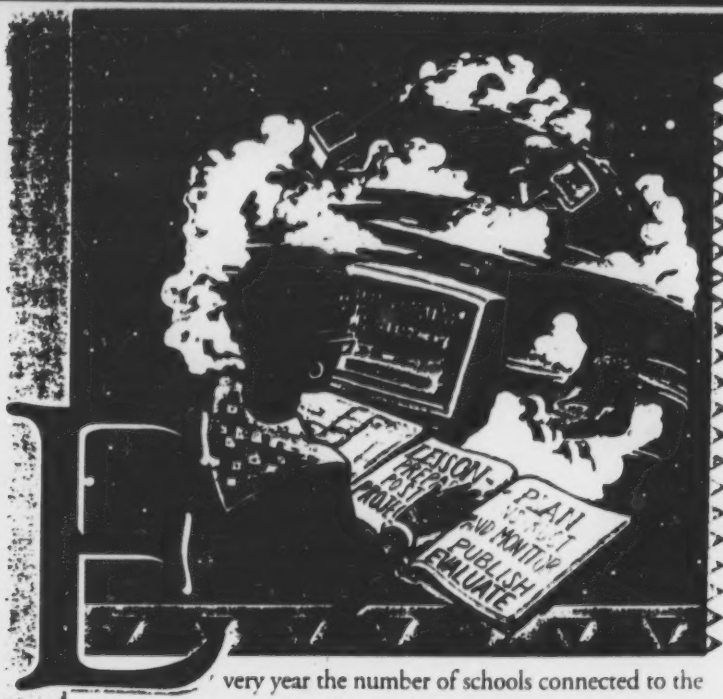
TEACHING on the INTERNET

Creating a Collaborative Project

The Internet can be used for more than just finding and publishing information. Consider collaborative projects: They can motivate students and give them a sense of the real world like no other classroom activity. This article presents the simple steps needed to host an online collaborative project—from designing it to planning for the future.

By Regina Royer



Every year the number of schools connected to the Internet grows, as does the number of teachers with their own e-mail accounts. As teachers become familiar with the Internet and its basic uses, they usually want to find deeper applications—such as collaboration—for their classrooms. These applications are limited only by a teacher's imagination. Kindergarten teachers, for example, could ask students around the world to send "hello" messages to their classes and then teach their students to locate the message senders on a map. Or French teachers could ask their students to exchange messages in French with native speakers around the world and students learning French as a second language. Science teachers might use the Internet to gather and share data between schools. (An example of this last type of project is the Great Penny Toss. See Paul Reese and Mona Monroe's article in the March 1997 issue of *L&L*.)

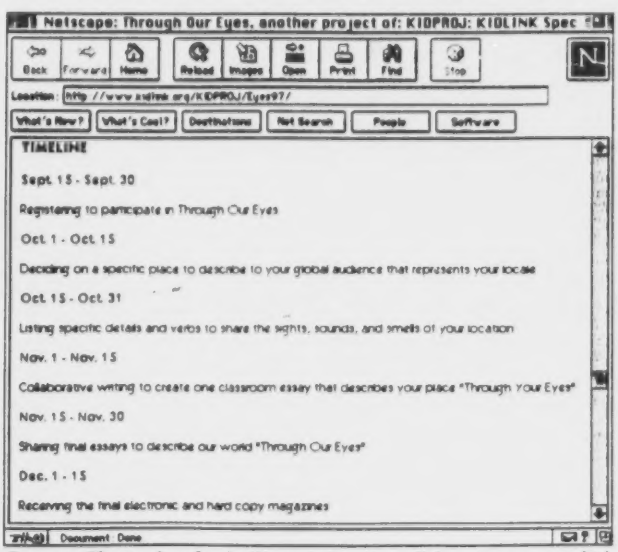

Netscape: Through Our Eyes, another project of: KIDPROJ: KIDLINK Spec
Back
Forward
Home
Reload
Images
Open
Print
Find
Stop
Location: http://www.xxiree.org/KIDPROJ/Eyes97/
What's New?
What's Cool?
Destinations
Net Search
People
Software
TIMELINE
Sept. 15 - Sept. 30
Registering to participate in Through Our Eyes
Oct. 1 - Oct. 15
Deciding on a specific place to describe to your global audience that represents your locale
Oct. 15 - Oct. 31
Listing specific details and verbs to share the sights, sounds, and smells of your location
Nov. 1 - Nov. 15
Collaborative writing to create one classroom essay that describes your place "Through Your Eyes"
Nov. 15 - Nov. 30
Sharing final essays to describe our world "Through Our Eyes"
Dec. 1 - 15
Receiving the final electronic and hard copy magazines
Document Done

Figure 1. The timeline for the Through Our Eyes collaborative project, which lasted only three months.

Many collaborative projects have already been posted on the Internet, but some teachers need projects that are more specifically tailored to their own curricula and student needs. Teachers can easily post requests for collaboration to listservs or in many different places on the Web (see "Where Can I Post My Project?" on page 11). Successfully creating and hosting your own Internet project, however, requires more than just posting such a request.

Through Our Eyes

I started my first collaborative project in 1995. Although Through Our Eyes (TOE) was only modestly successful the first time, it was a great learning experience. Of the 25 participants who registered, only 13 completed the project and only six followed the directions and submitted the project as assigned. After researching project design on the Internet, I concluded that even though helpful information could be found about how to set up and evaluate a project, little information was available online about hosting and moderating a project.

I hosted TOE again during the 1996–97 school year and examined the elements needed for successful Internet collaboration. This time, 23 of 33 participant classes completed the project (and all of them did so correctly); 7 countries and 13 states were represented by these classes. The *L&L* online supplements Web page (http://www.iste.org/publish/learning/supplements.html) contains links to TOE project postings.

From my two successful years of hosting TOE, I have determined that the following stages are essential for ensuring the success of any collaborative project:

- Preparing.
- Posting project objectives and requirements.
- Instructing and monitoring interactions.
- Publishing the project.
- Evaluating.

Each stage has its own substages, and these will be described in the rest of this article.

Prepare

Before you post your activity, you must design its elements just as you would a classroom lesson plan. Hosting a collaborative Internet project is like teaching a lesson to several classes at once.

First, you must create a project. What do you want to do during the collaboration? To answer this question, craft a statement of purpose, state the project's objectives, and create unit activities. The objectives should be closely aligned to your classroom's curricular objectives. The primary reason teachers give for not participating in more Internet activities is lack of time. If you want teachers to get involved in your activity, then you must make it clear that your project will address standard curricular objectives in a way that cannot be done in normal classroom lessons. This reward for participation will be unlike any other and will prove to be worth the time spent.

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Second, identify and then design a product. How will it look in its final form? How will it be shared or published? For TOE, I published both paper and electronic magazines that contained a few of the essays submitted.

Third, organize a timeline. Restrict the project to the shortest time frame possible. A semester is better than a year if you want to keep momentum going. Divide the project into activities that you can cluster into weeks (see Figure 1), and publish the activities by weeks (first week, second week, etc.) or dates.

Fourth, consider such Internet issues as schools' connection and Internet capabilities. Constant collaboration and contact are essential to a successful project, and as moderator you will need to create a forum for that to happen. Running your project through a listserv such as KIDLINK is one way, but creating a group in an address book will also work; you can do this by creating a mailing list of all participants in your e-mail software. In either case, all participants are in contact through e-mail not only with you as host but also with each other. You can also run your project solely on the Web, but this may limit the number of participants to those who have in-school Web access.

Finally, limit the number of participants. When posting your project, state the maximum number you can accept. Keep it manageable so that members do not feel lost, but also try to have enough participants to represent many different geographic regions. I limit TOE to 25 participants.

Post the Project

Once you have designed your project, post it on the Internet to find participants. You can post on listservs, on the Web, or both. Here are a few simple guidelines.

First, cross-post as much as possible so that you receive enough responses. "But aren't there endless numbers of Internet users who would love to contribute to this type of projects?" you ask. Unfortunately, no. After posting my project on three listservs with hundreds of members each, I received only 35 responses. Figure 2 shows the 1996–97 TOE project posting.

Second, remember to include some type of registration form (see Figure 3). If you are posting on the Web, you can create an HTML form that is e-mailed back to you. Or you can ask each applicant to e-mail you specific information when requesting a spot in your project. You can either list the information you need on your Web announcement or in an e-mail message sent to the listserv.

Third, respond to all registration forms that you receive. Acknowledge the teachers you accept and send them any further information you have. Also send messages to the teachers you must reject, letting them know that the project is full.

Fourth, once you start receiving registrations, post lists of who is registered and how many spaces are available. This will show the participants their own diversity and numbers, build enthusiasm among those who have already registered, and encourage others to join.

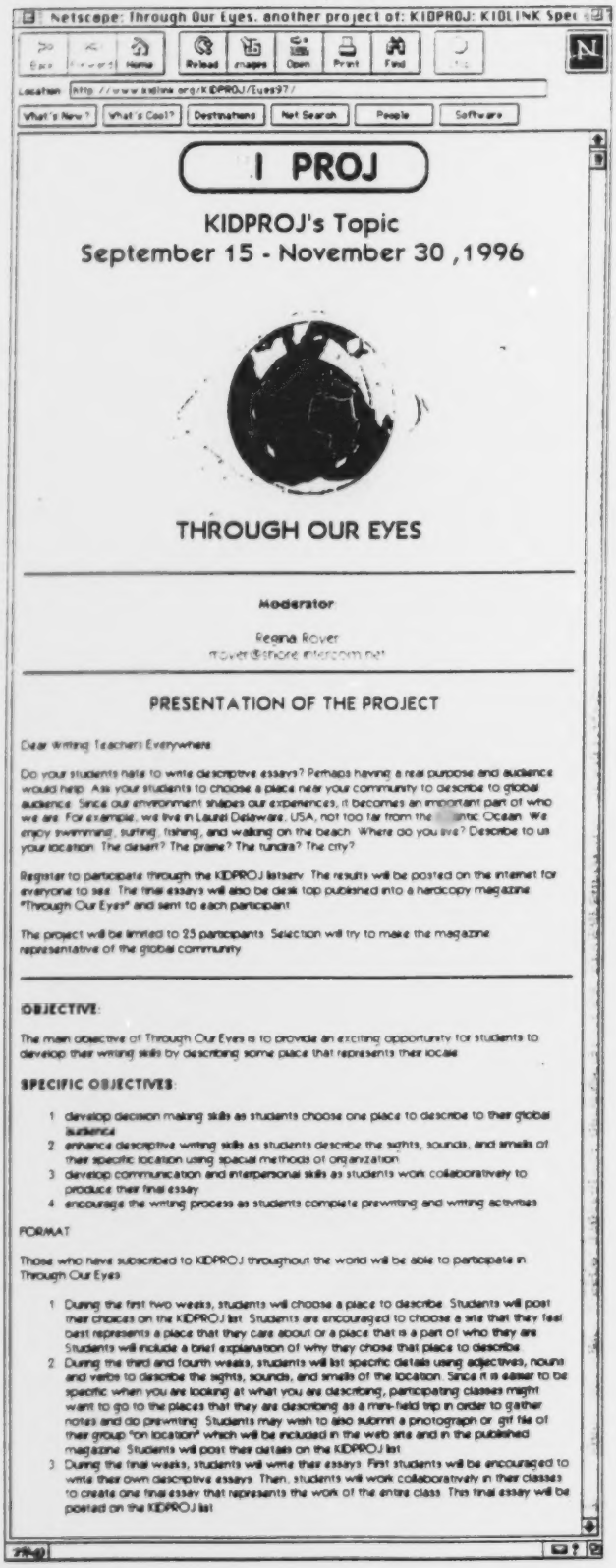
Netscape: Through Our Eyes, another project of: KIDPROJ: KIDLINK Spec
Reload
Images
Open
Print
Find
Location: http://www.kidlink.org/KIDPROJ/Eyes97/
What's New?
What's Cool?
Destinations
Net Search
People
Software
I PROJ
KIDPROJ's Topic
September 15 - November 30 ,1996
THROUGH OUR EYES
Moderator
Regina Rover
rover@shore.intercom.net
PRESENTATION OF THE PROJECT
Dear Writing Teachers Everywhere
Do your students hate to write descriptive essays? Perhaps having a real purpose and audience would help. Ask your students to choose a place near your community to describe to global audience. Since our environment shapes our experiences, it becomes an important part of who we are. For example, we live in Laurel Delaware, USA, not too far from the Atlantic Ocean. We enjoy swimming, surfing, fishing, and walking on the beach. Where do you live? Describe to us your location. The desert? The prairie? The tundra? The city?
Register to participate through the KIDPROJ listserv. The results will be posted on the internet for everyone to see. The final essays will also be desk top published into a hardcopy magazine "Through Our Eyes" and sent to each participant
The project will be limited to 25 participants. Selection will try to make the magazine representative of the global community
OBJECTIVE:
The main objective of Through Our Eyes is to provide an exciting opportunity for students to develop their writing skills by describing some place that represents their locale
SPECIFIC OBJECTIVES:
1 develop decision making skills as students choose one place to describe to their global audience
2 enhance descriptive writing skills as students describe the sights, sounds, and smells of their specific location using special methods of organization
3 develop communication and interpersonal skills as students work collaboratively to produce their final essay
4 encourage the writing process as students complete prewriting and writing activities
FORMAT
Those who have subscribed to KIDPROJ throughout the world will be able to participate in Through Our Eyes
1 During the first two weeks, students will choose a place to describe. Students will post their choices on the KIDPROJ list. Students are encouraged to choose a site that they feel best represents a place that they care about or a place that is a part of who they are. Students will include a brief explanation of why they chose that place to describe.
2 During the third and fourth weeks, students will list specific details using adjectives, nouns and verbs to describe the sights, sounds, and smells of the location. Since it is easier to be specific when you are looking at what you are describing, participating classes might want to go to the places that they are describing as a mini-field trip in order to gather notes and do prewriting. Students may wish to also submit a photograph or .gif file of their group "on location" which will be included in the web site and in the published magazine. Students will post their details on the KIDPROJ list.
3 During the final weeks, students will write their essays. First students will be encouraged to write their own descriptive essays. Then, students will work collaboratively in their classes to create one final essay that represents the work of the entire class. This final essay will be posted on the KIDPROJ list.

Figure 2. TOE's request for participants and description of project objectives as posted on the KIDPROJ Web site.

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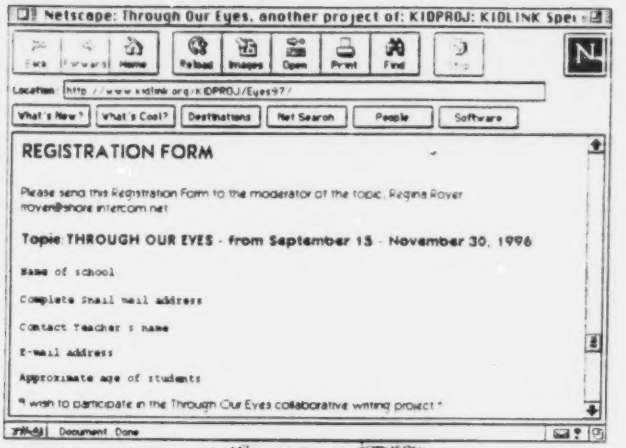

Figure 3. The TOE registration form. You can set up a Web-based mail form or ask participants to send e-mail that contains specific information.

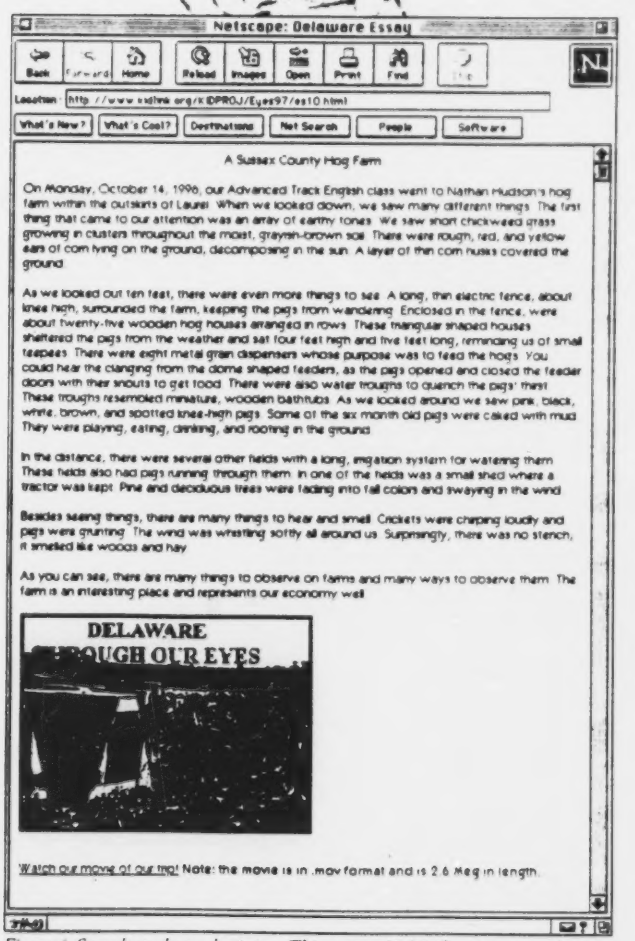
Netscape: Delaware Essay
Back
Reload
Images
Open
Print
Find
Location: http://www.kidlink.org/KIDPROJ/Eyes97/es10.html
What's New?
What's Cool?
Destinations
Net Search
People
Software
A Sussex County Hog Farm
On Monday, October 14, 1996, our Advanced Track English class went to Nathan Hudson's hog farm within the outskirts of Laurel. When we looked down, we saw many different things. The first thing that came to our attention was an array of earthy tones. We saw short chickweed grass growing in clusters throughout the moist, grayish-brown soil. There were rough, red, and yellow ears of corn lying on the ground, decomposing in the sun. A layer of thin corn husks covered the ground.
As we looked out ten feet, there were even more things to see. A long, thin electric fence, about knee high, surrounded the farm, keeping the pigs from wandering. Enclosed in the fence, were about twenty-five wooden hog houses arranged in rows. These triangular shaped houses sheltered the pigs from the weather and sat four feet high and five feet long, reminding us of small teepees. There were eight metal grain dispensers whose purpose was to feed the hogs. You could hear the clanging from the dome shaped feeders, as the pigs opened and closed the feeder doors with their snouts to get food. There were also water troughs to quench the pigs' thirst. These troughs resembled miniature, wooden bathtubs. As we looked around we saw pink, black, white, brown, and spotted knee-high pigs. Some of the six month old pigs were caked with mud. They were playing, eating, drinking, and rooting in the ground.
In the distance, there were several other fields with a long, irrigation system for watering them. These fields also had pigs running through them. In one of the fields was a small shed where a tractor was kept. Pine and deciduous trees were fading into fall colors and swaying in the wind.
Besides seeing things, there are many things to hear and smell. Crickets were chirping loudly and pigs were grunting. The wind was whistling softly all around us. Surprisingly, there was no stench; it smelled like woods and hay.
As you can see, there are many things to observe on farms and many ways to observe them. The farm is an interesting place and represents our economy well.
DELAWARE
OUGH OUR EYES
Watch our movie of our trip! Note: the movie is in .mov format and is 2.6 Meg in length.

Figure 4. Sample student submission. This page, which is from my own school in Delaware, contains a QuickTime movie.

Instruct and Monitor

All of the tasks that you perform as moderator of the project will fulfill at least one of the following three objectives.

1. Build motivation among participants.
2. Keep participants on track.
3. Ensure that projects get completed on time.

First, ask students to introduce themselves. Students can describe their typical school days, where they live, their hobbies, and so on. This activity builds enthusiasm among the participants and helps foster commitment to the project. One teacher in Montana commented that she and her students really enjoyed reading about each school involved. You also might create Web pages that contain descriptions of the schools and biographies and even pictures of the students. Be sure to discuss school- and districtwide acceptable-use policies with teachers before they submit pictures to accompany their projects. Parental permission may be required before student photos can be published, or they may not be allowed at all.

Second, break the project into small components. The end product may take weeks or months to complete. Motivation may flag, and participants may procrastinate. Or the project may seem really daunting. Keep the steps small and set weekly or biweekly deadlines. And send out reminders and updates weekly; include feedback, reminders about upcoming due dates, and descriptions of the assignments. You can also post or send out teaching ideas, samples of student work, discussion starter, and other teaching materials. Consider sharing the intermediate tasks on the Web or through a listserv.

Third, you can host a "coffee house" in which participants can discuss various portions of the project. If possible, organize a chat room using Internet Relay Chat. Or you can encourage e-mail exchanges. Continue to provide such opportunities for participant exchange throughout the project. These steps also help foster commitment to the project, which is necessary if teachers and students are to put forth the effort required to complete it.

Publish

Sharing the final product on the Internet is extremely important for the project. Research shows that students are more committed to their tasks and strive for higher standards when they see their work as important—and posting it on the Internet reinforces its importance.

First, whenever possible, I put the final papers on the Web and include graphics (see Figure 4 for a sample student essay).

Second, I send a paper version of the magazine and certificates of completion to each school. Most teachers copy the magazine for participating students and keep the original in the classroom or school library. This strategy seems to encourag the best possible work from students. Students enjoy seeing their contributions posted, especially when they understand that any-

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one can access them. Graphics really enhance the presentation and make it more likely that others will read the page closely. The certificates are a nice reminder of each student's contribution to the project, and the paper magazine is something they can review even when they cannot get to a computer.

Evaluate

When the project ends, evaluate your success.

First, perform your own evaluation, describing what did and did not work for you.

Second, involve the project participants by distributing questionnaires and soliciting comments. Keep the questionnaires short, and ask for comments from both teachers and students. You can ask participants to rate various components of the project on a scale of 1 to 10. You can ask open-ended questions such as "Would you change anything to make the project easier for the classroom teacher?" You can encourage comments by asking participants to complete sentences such as "I plan to ..." or "I wish that ..." Or you can combine these feedback strategies with other evaluation strategies. The goal is to collect useful information in a form that you can easily use.

Final Thoughts

Although hosting a collaborative project on the Internet requires a great commitment of time, its benefits outweigh its drawbacks. As one teacher from Washington state said, "The projects you offer are worth the time and effort!" Receiving messages like this one make the hours spent organizing the project worthwhile. Other teachers also expressed their enthusiasm about the project with comments such as "Don't change a thing" and "I plan to make more effort to get as many of my classes as possible involved in similar project ideas."

Students who are involved in collaborative projects that are directly tied to the curriculum are also more motivated and sense that what they learn has value beyond the classroom walls. As one TOE participant from Hawaii wrote, her "students took more pride in their writing, knowing that many other people would be reading what they wrote."

Other Internet-collaboration ideas can be found elsewhere in this issue of *L&L*. Ivan and Jean Baugh discuss e-mail collaboration on page 38, and Donna Moss and company describe desktop videoconferencing on page 49.

I first thought that TOE would be a one-time event. I decided to host the project a second time to learn more about Internet-based collaborative projects. But I've learned that many participants have expected TOE to be an annual event. So I'm beginning my third year, confident in the experience and knowledge I've gained and inspired by the enthusiasm of the participants. ■

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Where Can I Post My Project?

The following Web sites and listservs are great places to find teachers who are interested in joining your project. To post to a listserv, you must first subscribe. Follow the subscription instructions included in this sidebar and then send your posting to the proper address.

Global SchoolNet Foundation

http://www.gsh.org

This Web site contains a section titled "The Connected Classroom," which is designed to link classrooms all over the United States and the world. To register your project, select the Projects Registry link. Simply complete the online registration form with your project's details and objectives and then click the Register Your Project button. Your project will then be included in the Web site's calendar of active projects.

Intercultural E-Mail Classroom Connections

iecc-request@stolaf.edu
http://www.stolaf.edu/network/iecc

The IECC project lists are provided to help teachers and classes link with partners for e-mail classroom penpal and project exchanges. Send a message that contains the word "subscribe" to iecc-projects-request@stolaf.edu.

KIDPROJ

listserv@listserv.nodak.edu
http://www.kidlink.org/KIDPROJ

This listserv is a part of the KIDLINK organization, which is devoted to moderating classroom Internet projects. You can post both your request for participants and your finished project on its Web site. To join the listserv, send a message containing the phrase "subscribe kidproj *Your Name*" to listserv@listserv.nodak.edu. You can also have your project listed as an official KIDPROJ project. Submit project details to Patti Weeg at pweeg@shore.intercom.net.

KIDSPHERE

kidsphere@vms.cis.pitt.edu

This active listserv provides a forum for discussing educational issues. To subscribe, send the message "subscribe kidsphere *Your Name*" to kidsphere-request@vms.cis.pitt.edu.

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WETWARE

Why Use Activity Structures?

Sometimes ready-made Internet lesson plans can be more trouble than they are worth. You may try a promising plan in your classroom only to watch it fail. Or you may try adapting one to fit your students or your school's level of technology. At some point in this process, though, you probably begin to think that you should have started from scratch. In this month's Mining the Internet column, Judi Harris offers instructional-design tools—activity structures—that really work.

By Judi Harris

What have you already learned to do with the Internet? Please think about this question and then make a list. (Go ahead! I'll wait.) Does your inventory look something like this?

- information searching
- online publishing (e.g., creating World Wide Web pages)
- using e-mail
- using discussion forums such as
- [illegible] chatting
- [illegible] and videoconferencing
- exploring online simulations such as
- [illegible]
- [illegible] acceptable use policies

Do you see any patterns as you [illegible] least one [illegible] important [illegible] your thinking as educators and that points to a primary theme of this column: Most of our Internet-related learning to date has been about *tools*—specifically, software that can help us locate and create information, either individually or collaboratively. As we've learned about the Internet, we've mostly learned to use Internetworked tools.

As teachers, we know that even the most powerful educational tools do not directly help our students learn. What's important is how we *use* the tools to assist teaching and learning. In other words, there is a big and important difference between using the *tools* (operation) and *using* the tool (application).

Operating Internetworked tools is an important first step in creating powerful collaboration and research issues. [illegible] apply the tools in [illegible] educational activities is [illegible] difficult. Student [illegible] education [illegible] in-depth investigation [illegible] complex [illegible] applications to explore [illegible] of our workshops, conference [illegible] Internet-related publications [illegible] how to apply Internet-based tools in elementary through [illegible] curricula. Why, even when they [illegible] successfully integrated, [illegible] assumption. But that explains this lack. I presume that learning to *operate* hardware and software is most of what's needed for successful integration of technology into our classrooms. How we successfully *apply* technology to educational situations is assumed to be obvious once the tools themselves are known. This is part of what Seymour Papert has [illegible] dubbed "technocentric thinking" (p. 22). In and of itself, the tool [illegible] make learning happen. However [illegible] powerful its features are, [illegible] the hands (in this case, the [illegible] is [illegible] competent, he or she [illegible] a [illegible] educational realm, far [illegible] when [illegible] plans for the educational [illegible] of this new tool. [illegible] that I invite you [illegible]

[illegible] Please Note

[illegible] list of what you [illegible] working with the Internet [illegible] curriculum integration [illegible] you have participated in [illegible] development activities that were designed to help you use [illegible] tools as resources in your curricula. As I'm already warning, I'll speculate some more during these curriculum-integration discussions. Were you told about successful projects in other classrooms? Shown online places to go that contained large

collections of lesson plans and project examples? Encouraged to try these ideas in your own classroom?

"What's wrong with that?" I hear you asking. "Real-world applications that work in real classrooms with real students are far more helpful than college professors' theories!" (Don't worry; I won't take that thought personally.) I agree with part of what you may be thinking on this issue. Stories of activities and projects that worked well in other teachers' classrooms are indeed helpful to us, but perhaps in a different and unfamiliar way.

Can you remember an instance in which you borrowed an idea for an activity or project that had worked well in another classroom? The idea might have been successful with students who were similar to your own in age, background, and interest. The curricula for both groups of pupils might even have been comparable. But think back and remember what happened when you last tried to "plug and play" an idea from another classroom into your own. How well did it work? Be honest; how well did it *really* work? Not so well, eh? If it was successful, then think carefully about what you did while you were planning its implementation. You had to change it a bit to get it to work well with your students, didn't you? And if you didn't think to do this—perhaps you used someone else's classroom activity when you were much less experienced as a teacher or when you were particularly pressed for preparation time—the activity fizzled, didn't it?

Why is this so? Why does the same educational activity flourish in one classroom and falter in another—even when students, curricula, and materials are similar? As teachers, the answer is obvious to us. Classrooms, students, teachers, and available resources all differ. Teachers' and students' prior experiences and content-related comprehension vary. Group dynamics are different. Differences can even result from the times of day, week, month, or year at which new activities are introduced.

Think about what your students are like at the beginning of the day, just before and after lunch, and at the end of the day. If you didn't know better, on some days you might suspect they weren't the same people. Now contrast students' behavior during the first week of school, the last week before the winter holidays, and a week in late February. Same class? Not really. If we know about the wide range of differences—biological, psychological, social, historical, and temporal—among students' receptivities to educational activities, then why do we believe, even for a minute, that we can successfully plug and play someone else's wonderful project into our classroom?

The answer is, of course, that most teachers do not really believe that learning to apply a new tool educationally is just a matter of plug and play. Most of us know we should tweak an idea to fit the unique nature of the context (learning and teaching styles and preferences, past experience, resource availability, etc.) in which they work. We expect to learn from mistakes and unexpected reactions when an idea is first used. Yet we know from both experience and research (see Rogers, 1995) that tweaking someone else's idea is not nearly as satisfying, or as effective, as *designing* an activity that fits the unique combination of factors that present themselves in our particular classrooms. Reinvention, the process of taking something such as a new tool or idea and making it our own, is important to both teachers and students. Feelings of ownership are crucial if new tools are to continue to be employed in ways that will benefit users. This is what is known as true adoption of the innovation (Rogers, 1995). Think about it. Which is more satisfying: watching an original idea that you created succeed or observing someone else's idea that you borrowed and tweaked get a good reception?

When we are asked to wade through large collections of lesson plans, replicate projects from other classrooms, or follow overly prescriptive directions for educational activities written by folks who cannot possibly know our students as we do, we are asked to ignore much of what experience and reflection have taught us. Using Internet tools and resources in our classrooms in ways that will benefit students and teachers—in ways that are truly worth the time, effort, energy, and expense—means we must function more as *instructional designers* than as direction followers. Creating and implementing learning activities as a designer is an artisan's endeavor. I speak to you as that artisan—as chef rather than cook, conductor rather than metronome, educator rather than automaton.

I can hear some of you thinking, "I don't have time or space in my curriculum to be an artisan!" It's true that as the years pass and our schools and communities change, preparation time for teachers dwindles while demands for additions to our curricula increase in number and complexity. So, I will not suggest that you "reinvent the wheel" or add anything more to your already crowded program. Instead, I propose the use of some *wetware* tools, or thinking apparatuses, that will help you engage in the important design processes that we know are essential to powerful, regular use of new tools in our classrooms. These thinking tools are created in such a way that they can assist your design work in a time-efficient, energy-conserving manner.

Is It Worth It?

What's one way to save time and energy in our classrooms? Choose educational activities that give students maximal return for the amount of time and effort that we all must expend to ensure success. We each estimate a point of diminishing returns when we consider using a new technique. In a phrase, we decide whether the application is *worth it.* For example, in educational telecomputing, is the specific use of an Internet-based tool or resource in a particular situation or for a particular group of students and teachers worth the time, effort, and expense that will be needed to use the tool or resource in this way? Note that this is not a unilateral decision about all internet-worked information and implements for

ail time. Instead, answers to the question "Is it worth it?" will change as people and resources change. The ease and speed of Internet access in your school and classroom will continue to change. As you and your students learn more about and do more with internetworked tools and resources, you will continue to change, too.

How can we best decide each time we are called on to do so, and how can we help others make such decisions? While we keep in mind a specific and feasible educational use of the Internet (in terms of both content and processes that students need or want to learn), we must consider honest answers to two questions:

1. Will this use of the Internet enable students to do something that they *could not do before?*
2. Will this use of the Internet enable students to do something that they *could do before but can do better now?*

If the honest answer to both questions is no, then we have no reason to use Internet tools or resources in the way we are considering. Our time, effort, and resources would be better used in another way. In any particular instance, if using traditional tools and approaches allows students to learn just as well or better than using new ones, then it doesn't make sense to use new tools in traditional ways. It isn't worth it to do so, for students *or* for teachers.

Usually, new tools are only worth using if they can be applied in new ways to help make worthwhile things happen in our classrooms. "Well, that's obvious," you might be thinking. Perhaps, but whenever we are offered new tools, something interesting happens. Most of what we first do with new tools looks much like what we did with older tools that were functionally similar to the innovations.

When teachers first used e-mail and electronic bulletin boards in elementary, middle-level, and secondary classrooms in the early 1980s, for example, what kinds of projects were most prevalent? Keypal projects! This makes sense when we realize that e-mail was first compared to surface mail, its similar but slower predecessor. Penpal projects were successful in classrooms long before networked computers were even in the world. At first, e-mail was seen simply as faster surface mail, but as users experimented with and exploited this global communication tool, our visions of e-mail's educational uses expanded. Now interpersonal exchanges can help students learn in at least seven different ways (keypals is only one; the other six are described later in this article).

How can we teachers use telecomputing tools and resources in powerful, curriculum-based ways that are worth it, while still making sure that we function as instructional designers without overburdening our already challenging workloads and schedules? We can consciously use design tools—along with a wealth of corresponding real-world, classroom-tested project examples—to create, efficiently and effectively, curriculum-based activities for our unique classrooms. These design tools are not prescriptions, step-by-step directions, or blackline masters. They are a special type of thinking tool that I call an *activity structure.*

Wetware Tools: Activity Structures

What *is* an activity structure? It is *not* a model, template, plan, mold, or example. It is a flexible framework, much like the wooden frame of a house or the skeletons in our bodies. Its basic shape is clear, strong, and simple, but, as with houses and humans, the same frame can support a myriad of different architectural or bodily expressions. The structure literally holds up the house, *creating spaces* for living. In a similar way, activity structures can support the generation of powerful educational environments, or spaces for learning and teaching, that are constructed, decorated, and used in customized and ever-changing ways, according to the needs and preferences of their inhabitants.

Want an example? Okay. Please think of one of your very favorite educational activities to do with students, one in which the students are *actively* involved with their own learning. (Now, *really* think of one, okay? I'll wait.) In a moment, I will ask you to work with this sample activity in a particular way. To show you how, here's an example from my own middle-level teaching experience.

I taught sixth grade, all academic subjects, in a school just outside Philadelphia. In language arts class, instead of asking students to memorize and use predetermined lists of vocabulary words, I helped them form personalized vocabulary lists each week that were drawn from both their individualized and common reading in every subject. To help them develop their skills in recognizing and deriving meanings of unfamiliar words, we used "vocabulary sniglets." Do you remember sniglets? Rich Hall, their creator, says a sniglet is "any word that doesn't appear in the dictionary, but should" (Hall, 1984). Here are two examples, excerpted by an anonymous "Internet Angel" and shared on the Web by Tina Mancuso at http://data.club.cc.cmu.edu/~tina/humor/sniglets.html/:

accordionated
(ah kor' de on ay tid) adj.
Being able to drive and refold a road map at the same time.

carperpetuation
(kar' pur pet u a shun) n.
The act, when vacuuming, of running over a string or a piece of lint at least a dozen times, reaching over and picking it up, examining it, then putting it back down to give the vacuum one more chance.

elecelleration
(el a cel er ay' shun) n.
The mistaken notion that the more you press an elevator button the faster it will arrive.

phonesia
(fo nee' zhuh) n.
The affliction of dialing a phone number and forgetting whom you were calling just as they answer.

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So, the activity structure is a teacher's instructional design tool—a piece of wetware. It is a way for us to converse with ourselves and others and capture what is most powerful in a particular type of learning activity and communicate it in a way that encourages the creation, not replication, of individualized, context-appropriate environments for learning.

The activity structure really is like the frame of the house.... The frame gives shape and strength to the actual learning activity.

Do you see how examining the different parts of words and their linkages help us understand the meaning of the whole word? I invited my students to construct sniglets out of phonemes in the same way and share them with the class. This process emphasized that different meanings could be created when different word parts were concatenated. We even wrote programs in Logo that told a computer to generate random sniglets. Our challenges were to figure out what the new words meant and find good uses for them in sentences and stories.

Now, how might educators typically classify that activity? Language arts? Vocabulary? Middle school? If we study this example in a quite different way, you might more easily see the activity's structure. Extract both the content and grade level from our description of the activity and see what's left. In this vocabulary sniglets example, students individually used units of meaning as building blocks in combination, then deduced definitions from the playfully formed concatenations according to what they knew about the meanings of individual units and their placements with reference to each other. Can you see how this description of the activity depicts only what the students do without reference to the content area or level of learning?

What follows shows the most powerful features of an activity structure. How might the previously described structure be used in a different content area and at a different instructional level? (Yes, I'd really like you to pause and brainstorm answers to this question.) You might use this activity structure in secondary chemistry classes when introducing students to the periodic table and the ways elements combine to form compounds. What if students were asked to form compounds and then research their relative stability according to the patterns of protons, neutrons, and electrons in each element? Do you think they might enjoy deducing what kinds of compounds and chemical reactions result when they combine different elements in differing amounts?

The same activity structure could be used in an early elementary art activity. You could ask students to combine different primary paints to see what secondary colors formed. You could then ask them to try to predict the resulting hues before actually mixing the paint. In a middle school music composition class, students could experiment with note combinations to form resonant or dissonant chords. In a high school geography class, students studying the development of different civilizations could use a simulation program to create different patterns of historical development based on geographic region, weather patterns, natural resources, or population density.

Do you see how the same activity structure can be used to create powerful, similarly structured learning activities for many different content areas and many different levels? Now, recall the sample activity I asked you to choose earlier. How might you successfully use that activity's structure in different curriculum areas and at different grade levels?

So, as you can see, the activity structure is a teacher's instructional design tool—a piece of wetware. It is a way for us to converse with ourselves and others and capture what is most powerful in a particular type of learning activity and then communicate it in a way that encourages the creation, not replication, of individualized, context-appropriate environments for learning.

It's as if the activity structure is the frame of the house, resting firmly on the conceptual foundation of this architectural approach to building potentially powerful learning spaces. The frame gives shape and strength to the actual learning activity, but it is completely flexible so that the walls, roof, doors, windows, and decor are content-specific, student-centered, individualized according to preference and past experience, and reflective of locally available resources. The same frame can support many houses whose external appearances and intended functions are quite different. Which do you think would result in houses that are maximally serviceable and aesthetically appealing—limiting architects to a standard procedure for design with little room for variation or inviting the exercise of their expertise and creativity? Would you rather live in one of many "little boxes," as Malvina Reynolds sang about in the 1960s, or in a more expressive creation? I suspect our students would rather learn in decidedly "unboxlike" spaces. It is essential, therefore, to all of the inhabitants of the space for us to practice instructional design in the same spirit of architecture and crafting, rather than replication and assembly.

Telecomputing Activity Structures

Some of you may wonder why I am emphasizing this notion of flexible frameworks for instructional design. When you thought about the sniglets example, did you shrug your shoulders? Were you unimpressed with the notion? Did you think that activity structures do not need to be

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consciously processed, because we use them quite effectively without realizing it? Perhaps, but with one important proviso. Specific activity structures are often limited in scope and application by the tools and resources that are available to implement them. In other words, existing activity structures are often best applied using existing instructional tools. Remember the "Is it worth it?" test? If a particular educational use of Internet tools and resources is going to be worth using according to the definition I gave earlier, then it must enable students to do something they need or want to do: either something they have not been able to do before or something they have not been able to do as well. Using *new* structures to design curriculum-based educational telecomputing activities can help us to increase the chances that these applications will be both "worth it" and custom-tailored to the unique combination of characteristics that describe a particular group of students working with a particular teacher in a particular classroom, school, and community context.

To date, I have identified 18 telecollaborative activity structures. I have grouped them into the following three categories of online educational activity:

1. Interpersonal Exchange
   a. keypals
   b. global classrooms
   c. electronic appearances
   d. telementoring
   e. question-and-answer activities
   f. impersonations
2. Information Collection and Analysis
   a. information exchanges
   b. database creation
   c. electronic publishing
   d. telefieldtrips
   e. pooled data analysis
3. Problem Solving
   a. information searches
   b. peer feedback activities
   c. parallel problem solving
   d. sequential problem solving
   e. telepresent problem solving
   f. simulations
   g. social action projects

Want to Learn More?

Have I interested you in using activity structures to plan curriculum-based telecomputing projects? Do you want to learn more? Brief descriptions are available online at http://lrs.ed.uiuc.edu/Mining/, in the March, April, and May 1995 columns indexed there. Project examples are catalogued by activity structure at http://lrs.ed.uiuc.edu/Activity-Structures/. Finally, a more in-depth exploration of designing and directing K–12 telecollaboration and teleresearch has recently been published by ISTE. *Virtual Architecture: Designing and Directing Curriculum-Based Telecomputing* was written by your humble columnist. As a matter of fact, you have just read most of the first chapter. I hope that you now want to read more. ■

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Judi Harris' Network-Based Educational Activity Structures

There are three structure genres with five to seven activity structures per genre.

- Collaborative Problem-Solving Projects
  - Electronic process writing
  - Information searches
  - Parallel problem-solving
  - Sequential creations
  - Simulations
  - Social action projects
  - Virtual gatherings

- Information Collections
  - Database creation
  - Electronic publishing
  - Information exchanges
  - Pooled data analysis
  - Tele-fieldtrips

- Interpersonal Exchanges
  - Electronic appearances
  - Electronic mentoring
  - Global classrooms
  - Impersonations
  - Keypals
  - Q-and-A Services

These network activities were collected and categorized into the Activity Structure classification by Judi Harris, jbharris@tenet.edu; Department of Curriculum and Instruction; 406 Sanchez Building; University of Texas at Austin; Austin, TX 78712-1294.
Phone: 512/471-5211

They were converted to HTML by Jim Levin, jim-levin@uiuc.edu; College of Education; University of Illinois, Urbana-Champaign; Champaign, IL 61820.

Many of Judi Harris' "Mining the Internet" columns from *The Computing Teacher* are available on the Learning Resource Server at the College of Education, University of Illinois, Urbana-Champaign.

http://lrs.ed.uiuc.edu/Activity-Structures/Harris-Activity-Structures.html

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WWW Constructivist Project Design Guide

This is a guide to initiate experienced educators into designing constructivist, cooperative learning projects around the World Wide Web. Examples of projects inspired by this guide include The American History Archive Inquirer and the Dalton Astronomy Internet Project. LiveText development is premised on the belief that the educational applications enabled by networked multimedia technologies will provide the opportunity for educational reform in accord with the pedagogy articulated in the Institute's white paper, "A Pedagogy for the 21st Century".

This hypertext document is organized into seven sections: an

1. Introduction, which assembles relevant pedagogic and learning theory to inform planning for constructivist projects,
2. Web Page Design,an introduction to hows and whys of the World Wide Web for instructional use,
3. Preparation,a guide to finding needed instructional resources on the Internet,
4. Student Surfing,a guide to helping students find and organize internet resources,
5. Concept Formation,a guide to helping students conceptualize and contextualize their findings,
6. Research,ways to extend their discussion to other sources and experts, and
7. Exhibitions,a discussion of multimedia resources in the context of portfolio and program assessment.

INTRODUCTION

You've managed to get access to the World Wide Web in your classroom and you want to develop a a Problem-Based (Webpage: Wheeling), Cooperative Learning (Balkcom, 1992) Internet-Based Research Project

(Schools of the Future, Australia) which is sensitive to: Learning Styles (LiveText), and Constructivist pedagogy (LiveText) and provides Relevant Learning Experiences (Ross, 1994 at CIC.Net) through accessing and building Learning Communities (Webpage at Boulder) on the Internet. How do you start?

Possible starting points depend, of course, on what subject or grade you teach. The first step would be to give your students some experience with the subject you are going to focus on, from lunar landings to community activism. A constructivist would put students directly in touch with primary materials, rather than articulate for

them the broader framework and connections to be made ahead of time; this way, students can become "infotectives" and Graze the Net (McKenzie, 1993) for resources that touch them most, and note their personal responses unmediated by specific assignments.

The number of computers in the classroom with access to the World Wide Web will determine what other concurrent activities will have to be run. It is recommended that no more than two students share a computer workstation at a time for Web browsing, unless they're quite patient and cooperative--it's an analogous situation to who's holding the remote control for channel-hopping.

WEB PAGE DESIGN

Can your student write their own web pages in HTML (ILTweb)? I've known classes of students as young as fourth graders who were taught to code HTML, and if you've made sure at least one student in each workgroup is a quick learner of computer skills, you should be all right. It would be helpful to spend a few weeks training a "core" of HTML programmers--this is a task that could be farmed out to high school or college student volunteers. New HTML coding software makes this a much easier task, and there are a number of Web Development Resources (LiveText) available to help.

The advantage of building web pages with every lesson as that these become resources for future lessons and serve as a record of what's been done. Each school with robust web-access should be developing its own server and filling it with the results of its classroom activities. For an example of such a web site, visit the Ralph Bunche School (Home Page).

PREPARATION

But where do you point students? Do you arm them with a set of search engines and set them loose on the Web? Preparation is critical at this stage. You could collect sites that list Resources by Subject (LiveText) in a relevant area. You might consider setting spiders (like webcrawler) in motion well before a lesson, then putting together a hotlist of sites for students to explore. Verify that the links work, and don't send students to sites with inappropriate material unless you've included making such judgements as part of the activity. (For more on this area, read about acceptable use policies.

STUDENT SURFING

If you let students browse the web, they should be putting together their own hotlists of the sites they feel are appropriate. If your hotlist has 20 items, theirs could have, say, five. Ask them to choose wisely, because their next task will be to write a "review" of their favorite sites: what do they like, what do they find interesting, what do they want to know more about, and MOST IMPORTANTLY what "adultese" do they need translated?

As your students formulate their reactions to the resources they've found on their hotlists (which were saved to their network accounts, if they had them, and to their folders/directories, if they didn't, for future editing) you can organize a cooperative Group Investigation using a database to catalog and review the resources. The presentation of findings could be a web page or even student-made charts.

CONCEPT FORMATION

Whether you've simply collected and shared student responses or run a group investigation of found resources, you now have an idea of what your students are responding to and what questions the materials suggest to them. You may at this stage want to regroup students by interest and form workgroups; or you may wish to do some "frontal teaching" to give the class concepts they haven't yet mastered that would help them direct their searching more effectively. One excellent method for this is Semantic Mapping. The American History Archive Inquirer is an example of how semantic mapping, resource digitization and group inquiry projects can work in tandem. Depending on what your goals are for the activity, you can determine at what point the students have the conceptual tools they need to proceed. In constructivist pedagogy, it is better to give too little than to much in this area; it is enjoyable, as a teacher, to make connections for our students, but more

enjoyable for them to discover the connections themselves. Yet without certain underlying principals connections will be out of reach.

RESEARCH

Although students have had a chance to look at and respond to a number of resources, they haven't yet taken a "researcher" position to them. What information are they seeking, and how will they use it? Now they return to their web sites and download text, images, video clips, and audio clips to use in constructing their own pages. Those of us suffering from "information overload" make the mistake of assuming we've read something when we only know where it is (like taking credit for unread books on our bookshelf) and students are no exceptions! How can you make students accountable for the content of the resources they've decided to work with?

Evaluating found sources on the web is an excellent opportunity to model and teach critical thinking and media literacy to students. Guidelines for such critique can be found in the Internet Source Validation Project (Bishops High School), a primer on evaluating the validity of found sources. If your school is lucky enough to have a library or one within reach, or a museum nearby, now is the time to take your class there for other resources to compare to those online for presentation and utility. If not, there are a number of Virtual Museums (LiveText) which are fun to visit, depending on their relevance to your topic.)

A perfect way to share information and get assistance with research questions is email. Students should be encouraged to explore appropriate Online Communications (LiveText), e.g. Listservs and Newsgroups, related to their topic, if they have their own email accounts; if not, you can subscribe on their behalf. This gives them a window on the discourse on these topics taking place over the network. Alternately, students can establish email communication with experts in the fields they are studying--you can suggest people for them to contact ahead of time, or they can look for them using tools such as the WHOIS (Webpage at MIT). The engagement in academic dialog with experts and each other may, for some students, be the most motivating and enlightening part of this project.

EXHIBITION

Whether it's a debate, a museum exhibit, a web page, a movie, a comic strip, a formal paper or a board game, it's time for your student workgroups to put together their findings and present them to each other in the form of an exhibition, an assessment standard developed by Ted Sizer through the Coalition of Essential Schools (Webpage at Brown U., Sizer, 1982). To whatever degree you can, make a web page serve as a record of their work, and let the other teachers who might be interest know how to find it. You may discover that other classes are in a perfect position to use your students as experts, collaborate with them on related projects, or help them find the next stage in their inquiry process. The Dalton School's Astronomy Home Page is an interesting example of a constructivist classroom web-based project's electronic portfolio.

A major advantage of using web pages as a tool in the classroom, and particularly as a mode of student presentation, is that "electronic portfolios" are already generated by the activity, and teachers don't have to go around frenetically scanning things in after for Portfolio Assessment (Gopher at INet). When students save their work, make sure copies of successive iterations are not overwritten without being stored somewhere--this way, students can have a record of the progress they've made.

Could your students send the URL to their personal web page as a college application essay? As a curriculum vitae?

Further Thoughts

This document is a seed for teachers who know how to get students to ask questions, sustain dialog and work together cooperatively, and want to see what the Internet has to offer. Few enough classrooms actually have a workstation setup with access sufficiently powerful to take advantage of all these ideas. But if anyone has done similar things and created web pages documenting their work, this would be an excellent place to show them

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off! Want to visit other schools (Webpage at U. Minn.) with Web pages, courtesy of Hillside Elementary School (Home Page)?

Please email your comments to

livetext@ilt.columbia.edu

and we'll see how we can make this page more useful, interesting and accurate.

||| **LiveText** => **Resources** | **Readings** | **Schools** | **Curricula** |||

Live Text

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Return to The WebQuest Page

Some Thoughts About WebQuests

Bernie Dodge, San Diego State University

There are already thousands of schools connected in some way with the internet, and the number is increasing geometrically. There is no agreed upon terminology for the kinds of instructional activities they are creating for themselves, and the field would benefit from having a few clear categories to describe the new forms of learning environments now opening up to us. The purpose of this short paper is to give a name to what we're doing in EDTEC 596 and for the early stages of the Ed First Partnership and to propose a set of desirable attributes for such activities.

Definitions

A WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the internet, optionally supplemented with videoconferencing. There are at least two levels of WebQuests that should be distinguished from one another.

Short Term WebQuests

The instructional goal of a short term WebQuest is knowledge acquisition and integration, described as Dimension 2 in Marzano's (1992) Dimensions of Thinking model. At the end of a short term WebQuest, a learner will have grappled with a significant amount of new information and made sense of it. A short-term WebQuest is designed to be completed in one to three class periods.

Longer Term WebQuest

The instructional goal of a longer term WebQuest is what Marzano calls Dimension 3: extending and refining knowledge. After completing a longer term WebQuest, a learner would have analyzed a body of knowledge deeply, transformed it in some way, and demonstrated an understanding of the material by creating something that others can respond to, on-line or off-. A longer term WebQuest will typically take between one week and a month in a classroom setting.

Critical Attributes

WebQuests of either short or long duration are deliberately designed to make the best use of a learner's time. There is questionable educational benefit in having learners surfing the net without a clear task in mind, and most schools must ration student connect time severely. To achieve that efficiency and clarity of purpose, WebQuests should contain at least the following parts:

1. An **introduction** that sets the stage and provides some background information.
2. A **task** that is doable and interesting.
3. A set of **information sources** needed to complete the task. Many (though not necessarily all) of the resources are embedded in the WebQuest document itself as anchors pointing to information on the World Wide Web. Information sources might include web documents, experts available via e-mail or realtime conferencing, searchable databases on the net, and books and other documents physically available in the learner's setting. Because pointers to resources are included, the learner is not left to

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wander through webspace completely adrift.

4. A description of the **process** the learners should go through in accomplishing the task. The process should be broken out into clearly described steps.
5. Some **guidance** on how to organize the information acquired. This can take the form of guiding questions, or directions to complete organizational frameworks such as timelines, concept maps, or cause-and-effect diagrams as described by Marzano (1988, 1992) and Clarke (1990).
6. A **conclusion** that brings closure to the quest, reminds the learners about what they've learned, and perhaps encourages them to extend the experience into other domains.

Some other non-critical attributes of a WebQuest include these:

1. WebQuests are most likely to be **group activities**, although one could imagine solo quests that might be applicable in distance education or library settings.
2. WebQuests might be enhanced by wrapping **motivational elements** around the basic structure by giving the learners a role to play (e.g., scientist, detective, reporter), simulated personae to interact with via e-mail, and a scenario to work within (e.g., you've been asked by the Secretary General of the UN to brief him on what's happening in sub-Saharan Africa this week.)
3. WebQuests can be designed within a **single discipline** or they can be **interdisciplinary**. Given that designing effective interdisciplinary instruction is more of a challenge than designing for a single content area, WebQuest creators should probably start with the latter until they are comfortable with the format.

Longer term WebQuests can be thought about in at least two ways: what thinking process is required to create them, and what form they take once created.

Thinking skills that a longer term WebQuest activity might require include these (from Marzano, 1992):

1.	Comparing:	Identifying and articulating similarities and differences between things.
2.	Classifying:	Grouping things into definable categories on the basis of their attributes.
3.	Inducing:	Inferring unknown generalizations or principles from observations or analysis.
4.	Deducing:	Inferring unstated consequences and conditions from given principles and generalizations.
5.	Analyzing errors:	Identifying and articulating errors in one's own or others' thinking.
6.	Constructing support:	Constructing a system of support or proof for an assertion.
7.	Abstraction:	Identifying and articulating the underlying theme or general pattern of information.
8.	Analyzing perspectives:	Identifying and articulating personal perspectives about issues.

The forms that a longer term WebQuest might take are open to the imagination, since we have few existing exemplars to go by. Some ideas:

1. A searchable database in which the categories in each field were created by the learners.

2. A microworld that users can navigate through that represents a physical space.

3. An interactive story or case study created by learners.

4. A document that describes an analysis of a controversial situation, takes a stand, and invites users to add to or disagree with that stand.

5. A simulated person who can be interviewed on-line. The questions and answers would be generated by learners who have deeply studied the person being simulated.

Putting the results of their thinking process back out onto the internet serves three purposes: it focuses the learners on a tangible and hi-tech task; it gives them an audience to create for; and it opens up the possibility of getting feedback from that distant audience via an embedded e-mail form.

Examples

One example of a short term WebQuest is the WebQuest 1 exercise that EDTEC 596 students completed a month ago. The goal was to give them a sense of how Archaeotype, a simulated archaeological dig, was conceived and implemented at two very different school sites. The exercise took about 2 hours and involved students working in groups to answer a series of questions. They were given a set of resources to read and interact with which included project reports and theoretical papers on the Web, copies of a portion of the Archaeotype documentation, and directions to go to another room and interact with a teacher at Juarez-Lincoln via video conference, or with a staff member at the Dalton School in New York via speakerphone. The students broke up into groups to experience each of these sources of data and then spent time telling each other what they'd learned. The end result was that each person in the class could explain what Archaeotype was and what problems and successes came with its implementation.

Another example of a short term WebQuest is WebQuest 2 in which the student teachers examined a number of web pages put up by schools. The point of the exercise was to expose them to a variety of ways in which a school could portray itself on the web in preparation for their creating the O'Farrell web pages. By the end of the exercise they were able to articulate general principles of good and not-so-good design for school web sites.

(I'm still looking for examples of a long term WebQuest and am eager to receive any suggestions.)

Design Steps

Learning to design WebQuests is a process that should go from the simple and familiar to the more complex and new. That means starting within a single discipline and a short-term WebQuest and then moving up to longer and more interdisciplinary activities. Here are the recommended steps:

1. The first stage for a teacher in learning to be a WebQuest designer is to become familiar with the resources available on-line in their own content area. Toward that end, we've prepared a Catalog of Catalogs of Web Sites for Teachers. This provides short list of starting points for exploration broken down by subject matter discipline.

2. The next step is to organize one's knowledge of what's out there. Spending a few hours on Non-WebQuest 3 will guide the teacher in organizing the resources in their discipline into categories like *searchable database*, *reference material*, *project ideas*, etc.

3. Following that, teachers should identify topics that fit in with their curriculum and for which there are

appropriate materials on-line.

4. A template is available that guides the teacher through the process of creating a short-term, single discipline WebQuest.

By late April, we'll have multiple examples of these WebQuests available here while the students in EDTEC 596 move on to develop interdisciplinary WebQuests. The description of the design process for those more elaborate activities will be made available here on SDSU EdWeb as well.

References

Clarke, J. H. (1990). Patterns of thinking: Integrating learning skills in content teaching. Needham Heights MA: Allyn and Bacon.

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This is Draft 1.03, written in February, 1995 and last updated on May 5, 1997.

Any thoughts to add to these will be warmly welcomed. Please send feedback to bdodge@mail.sdsu.edu.

Return to The WebQuest Page

Completing Your WebQuest Template

Introduction | The Task | Resources | The Process | Learning Advice | Conclusion

Introduction

You have learned what WebQuests are and may have even completed some WebQuests. You have an idea for a WebQuest and are ready to write a student WebQuest that can be shared with other educators. If you have questions about how to prepare and share a WebQuest, you are at the appropriate place.

The Task

Describe crisply and clearly what the end result of the learners' activities will be. Your task, writing a WebQuest using this template might be sequenced as:

- Write a WebQuest using the WebQuest Template.
- Evaluate appearance and accuracy of WebQuest using Netscape to preview your WebQuest.
- Publish a Trial WebQuest on the Macomb County WWW server.
- Evaluate WebQuest with students and revise as necessary.
- Publish Evaluated WebQuest on Macomb County WWW server
- Repeat procedure.

Resources

Use this space to point out places on the internet (or physical resources in the classroom) that will be available for the learners to use to accomplish the task. Embedding the links within a description of the resource will also assist your learners to know in advance what they're clicking on.

- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?
- Link Title Here do you want to describe it?

The Process

1. Click here Web Quest Template to obtain the Word Processing Template, and save as a source document on your hard drive.
2. open the Template from your computer's hard drive with a simple text processor. For Windows *Notepad* and for Macintosh *Teachtext* or *Simple Text*
3. Enter your ideas for your WebQuest on the *text processor* Template.
    - If you need more explanation for the information you are asked to enter or ideas for how to

enter information, use the Learning Advice Document
- Read the Learning Advice Doument in the Netscape window.
- Return to text processor document and continue.
- You can print the document if you desire to have a hard copy of the document.
- If more help is necessary send an Email WebQuest Helpwith your request.

4. Save WebQuest with appropriate title and three (3) letter HTML extension (htm).
5. View the document in Netscape by using the FILE/Open File Command from Netscape.
6. Evaluate the appearance and accuracy of the WebQuest.
7. Publish a Trial WebQuest on MISD web server by:
   e-mailing the doucment to: WebQuest HelpWebQuest Publishing.

Learning Advice

Some WebQuest writers may wish to start out with pencil and paper, others may wish to go to WebQuest Template and do WebQuest without consulting or following most of the steps or consulting any of the materials. Other WebQuest writers may want to follow all the steps and consult all the materials.

It is anticipated you will find an approach to writing WebQuests that will use your own strenghts and probably change over time. Good learning advice is probably **JUST DO WEBQUESTS**. Probably the best learning advice is teach your students to do WebQuests.

Conclusion

Congratulations. You may now have published a WebQuest which will allow students to engage in meaningful learning using internet resources. Please help educators and students by continuing your publication of WebQuests, and helping colleagues develop WebQuests. If you have any problems, questions, or just want to talk about your efforts please Email below. You may also want to join the MISD Web Publishers.

This page written by WebQuest Team.
Last updated July 7, 1996

This page was adapted from Bernie Dodge 's WebQuest_Template1.html by Tom March

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six strategies for using the Web for learning

Hotlist | Scrapbook | Treasure Hunt | Subject Sampler | Intro WebQuest | Full WebQuest

Introduction

The following six activities were created as models for ways to integrate the World Wide Web into classroom learning. China was chosen as a topic because it exemplifies the kind of thinking the Web is great at fostering. Too often learning is reduced to disconnected facts and filtered perspectives. The Web offers a broader, more authentic learning experience. If you'd like more information about the benefits of each type of Web-strategy listed below, take a look at Working the Web for Education.

Hotlist

China on the Net is a starting point for anyone studying China. If you have your own learning activities in mind, you might find some of the links here to be useful.

Multimedia Scrapbook

Exploring China is for you if you want students to surf Internet links about China and download images, text, videos, music, etc. to put into their own multimedia scrapbook.

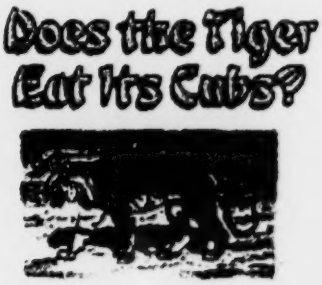
Treasure Hunt

The Treasures of China is your choice if you want students to gain "hard knowledge" (facts, information, news, history, etc.) about China. It exposes students to key aspects of China's rich past and controversial present.

Subject Sampler

My China is a good activity to choose if you want learners to engage their personal ideas, feelings and experiences with some specific aspects of China.

Introductory WebQuest



Does the Tiger Eat Its Cubs? is an inquiry-based activity that prompts higher-order thinking and collaboration. Challenge them to find the truth about reported mistreatment of orphans in China.

Full WebQuest

Searching for China is a culminating, unit-length activity challenging students to take on a specific role (i.e., foreign investor, human rights activitist, etc.) from which to view modern China. Students then need to come to a compromise solution to dealing with this complex and changing world power.

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By Tom March, tmarch@mail.sdsu.edu
Applications Design Team/Wired Learning
http://www.kn.pacbell.com/wired/China/
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a multimedia scrapbook activity

Introduction | Instructions | Places | Facts & News | Culture & Politics | Images | Tools

Introduction

Would you like to go to China? If you could, where would you go? What would you be most interested in seeing? The Great Wall? The Forbidden City? Maybe you would like to explore some of the natural settings like the Himalaya mountain range or Lushan Mountain or maybe the raging Yellow River or the Three Gorges. Even if you could tour all these sites, it's likely that you would learn more about a China that doesn't always make it into the guidebooks. China is in the midst of great growth and change.

You now have the chance to take a virtual tour of China. Explore those areas that are most interesting to you. Peek into places the typical tourist might not go. Be adventurous. And **bring back lots of souvenirs!**

Instructions

Your task is to surf through the Internet links below and find pictures, text, maps, facts, quotes, or controversies that capture your exploration of China. You will capture the text and images that you find inportant and then you will put them together in a multimedia scrapbook. Follow you interests, but be prepared to share why you chose what you did and what it means to you.

Several Tools are linked on this page to help you complete and show your scrapbook.

Specifically, you will:

1. Surf the Internet sites linked below.
2. Copy any text you want by dragging across the words then using the **Edit - Copy** command on the menubar.

Paste the Text into a basic text editor, word processor, desktop publishing program or multimedia software.

3. Save images you like by downloading them (**Note:**check with the authors of the page to see if any copyright rules apply. Usually students are allowed to download images that will only be used in the classroom. A good practice to get into is to use the email link on the page that has an image you want an ask permission. You might be surprised at the response you get.)

4. Either **paste the images** you've downloaded into a multimedia, paint or desktop publishing program (like HyperStudio, Clarisworks, or PageMaker) or use one of the graphics viewers listed as Tools on this page to display your collection of images.

5. Once you have created your scrapbook, go over it carefully so that you can give clear and thoughtful reasons why you found the things you collected especially important.

Places

- Study a Map of China (260K).
- Tour in China - brief background on the provinces and cities in China.
- The Cities of China from excite's city.net
- Images of Scenery and Sights in China - from the China News Digest
- Scenery from the Art of China Homepage

Facts & News

- The U.S. Army Handbook - read the Country Profile (overview) or any of 14 separate chapters (note: these are text documents).
- Current Issue of AsiaWeek from Time Magazine
- China News Digest - News bulletins updated every two days.
- Recent Articles on China from the Washington Post

Culture & Politics

- The Chinese Zodiac may offer you insights on yourself and people around you.
- Chinese Zodiac Fortune Page by Eric Ward
- Chinese Proverbs with Annotations and Connotations, compiled by Haiwang Yuan
- English Translation of Classical Chinese Poetry from China the Beautiful
- "The Way of Life," according to Lao-Tzu is a collection of Taoist (pronounced "Dowist") wise sayings.
- Frequently Asked Questions about Zen which was known as Ch'an in China.
- Deng Xiaoping from Time - Asia Week
- The Dalai Lama's speech on Compassion
- Seven Things You can do to Help Tibet
- Boycott "Made in China" Homepage
- OneWorld News Service's Page on China
- Nanking 1937 memorializes the Japanese massacre of Chinese citizens.
- The South China Morning Post is the leading English Newspaper in Hong Kong

Images

- A Day in the Life of China: Photos from Time magazine by China News Digest
- A Variety of Arts, from the Art of China Web site
- The Splendors of Imperial China from the Asian Art Museum of San Francisco
- Mongolia: The Legacy of Chinggis Khan, presented by the Asian Art Museum of San Francisco (use the QuickTime VR software to view artworks "in the round!")
- Chinese Painting - China the Beautiful
- Appreciation of The Art of Chinese Calligraphy from China the Beautiful

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Tools

References

- Hypertext Webster Dictionary lets you quickly get definitions to words. See if you can bookmark this as a favorite site so you can get to it easily.
- Roget's Internet Thesaurus allows you to find words that have similar meanings.

Software

- JPEGView (Macintosh) is great for showing images you get from the Web
- Lview Pro (Windows) lets you show pictures you get from the Web (click to download)
- HyperStudio is used at many schools. Check out the Website for support, ideas, and the Netscape Plug-In (requires Mac & Netscape 2.0)
- Shareware.com gives you access to thousands of software programs you may want to use to show off your scrapbooks.
- Of course you could use HTML and create a Web page of your scrapbook. If you want to avoid doing HTML we can think of creative ways to use Filamentality.

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Applications Design Team/Wired Learning
http://www.kn.pacbell.com/wired/China/scrapbook.html
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an Internet-Based Treasure Hunt on China

Introduction | The Questions | Big Question | Internet Resources

Introduction

When people think about "The Treasures of China," they usually picture a beautiful pagoda with golden dragons, or a gleaming statue of the Buddha, or the Great Wall's winding ribbon. But the true treasure of China is its complexity. During "The Treasures of China" you will uncover several aspects that might give you insights on such different things as the richness of China's cultural heritage, the wealth of its current economic boom, and the tarnishing that mars China's treatment of some of its people. The Treasure Hunt will help you find out some details about these issues and then bring your learning into greater focus by answering a Big Question: What is the truth about China today? Hint: each Internet link holds the answer for one question. Good luck!

Questions

1. As of 1995, what international disputes was China involved in with her neighbors?
2. How did China deal with earlier troubles with a neighbor to the north?
3. According to a fable, how does a person's life and dreams relate to each other?
4. What is China doing in Tibet that disturbs the Dalai Lama?
5. How did the Chinese of the Tang era prepare themselves for the afterlife?
6. How do Western and Chinese business people tend to view each other?
7. What are three reasons some people are calling for the boycott of Chinese products?

8. Describe an event that occurred after World War II that shows why China might fear its neighbors.
9. Why did China conduct missile tests near Taiwan in 1996?
10. What was Deng Xiaoping's defining motto and how does this relate to the changes he brought to China?

The Big Question

Your challenge is to come up with an answer to the question: What is the truth about China today? Consider what you learned about China's past, it's relations with neighboring countries, the state of its economy, and how it treats its citizens.

The Internet Resources

- CIA World Fact Book Chapter on China, 1996
- The Great Wall
- The Fable of the Master and the Servant
- The Dalai Lama's Speech Accepting the 1989 Nobel Peace Prize
- Horse (Tomb Figure), Tang dynasty
- "Negotiating and Building Effective Working Relationships with People in China"
- Boycott "Made in China" Homepage
- Nanking 1937 (memorializes the Japanese massacre of Chinese citizens)
- Taiwan Exercises Democracy, China Exercises Military Force
- Deng Xiaoping, leader of China

This Website created by Filamentality

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Education First / San Diego State
Last revised September 25, 1997

My CHINA

a subject sampler to pique your interest in China

Introduction | Internet Activities | Conclusion | Dictionary

Introduction

The following links come from all over the World Wide Web and represent a variety of aspects related to China. You may complete the following Internet activities alone or by working in a group. You may complete all or only some of the activities depending on your goals for the study of China. Also, feel free to use the HyperText Dictionary whenever you need to.

The purpose of this Web page is to give you a sampling of some of the aspects related to China. Each of the activities asks you to make a personal commitment to what you like, believe, or feel about a topic. Good luck and have fun!

Note: Clicking on the **bolded Internet links** on this page will open a new browser window so you can get back to these instructions and activities easily. When you've finished, close the new browser window and move on to another activity that interests you.

Activities on Chinese Culture and Current Events

Chinese Zodiac (try this Chinese Zodiac site too)

Activity:

1. What animal represents the year you were born?
2. What aspects of your zodiac seem true in describing you?
3. Who is a famous person born in the year of the same animal?
   (if you don't know any of the people, choose one and do an AltaVista search on the name after putting it into quotation marks)

Chinese Proverbs

Activity:

1. Copy a Chinese proverb you like.
2. State what the proverb means (use the annotation and your own good ideas).
3. Write a modern American version that shares the same meaning.

The Way (or The Tao Te Ching), by Lao Tsu

Activity:

1. Skim through the numbered passages until you find one that makes sense to you.
2. Copy the passage/poem down.
3. Put the passage's meaning into your own words line-by-line.

The Discovery of His Holiness the Dalai Lama of Tibet

Activity:

1. Read through the description of how the current Dalai Lama was discovered.
2. Make a note of the most interesting/important 3 - 5 points made in the article.
3. Describe in writing or to a friend or your class what your beliefs are concerning this discovery.

China News Digest

Activity:

1. Click on the "current issue" to read the latest news in China.
2. Skim through the issue until you come across something that you think is either interesting or important.
3. Describe in a solid paragraph what's being discussed and why you thought it was interesting or important.

The Splendors of Imperial China

1 10

Activity:

1. Browse through the exhibit presented by the Asian Art Museum in San Francisco.

2. Choose the image that you like the best, read about it a bit, and then view the larger image of it by clicking on the "thumbnail."

3. After looking closely at the image, describe how the details of the piece you selected make it a special work of art.

Boycott "Made in China" Homepage

Activity:

1. Read through the Web site looking for key ideas.

2. Decide whether you think people should boycott Chinese products.

3. Describe in a detailed paragraph or essay your reasons for saying we should or should not boycott Chinese products.

Conclusion

You have had the opportunity to explore some important aspects of China: its religions, beliefs, arts, and current events. Think about the people you know. Do they ever surpise you with what they do? People have different needs and goals so sometimes they are pleasant and friendly, but sometimes they can be aggressive and mean. If people can be this way, it shouldn't be a surpise that a country made up of billions of people and with a long and changing history might act in surprising ways too. To get an even better understanding of the different faces of China, you can get a group of five people together and go off Searching for China.

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Does the Tiger Eat Its Cubs?

A WebQuest on Children & China

Click on the title to explore its meaning.

Introduction | The Process & Resources | Conclusion | HyperText Dictionary

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Introduction

Reports have come out of China suggesting some terrible things about the way children are treated in Chinese orphanages. As with most things relating to this complex country, it's hard to tell what's true and what is propaganda. In this WebQuest you and your teammates will explore reports about how children are treated in China, the U.S., and other related topics. Your task is to come up with your team's version of the truth. In other words, your job is to prove the old Chinese proverb, **Paper Can't Wrap Fire.**

To unwrap the truth about how orphaned children are treated in China you and your teammates are going to read background articles, learn how there are different opinions on the topic, discuss your ideas and feelings with your teammates, write a thoughtful letter, and mail the letter using Email or the U.S. Postal Service to real people in the world who care about your opinion.

The Process and Resources

Here's the step-by-step process you'll use to do to decide whether the **tiger eats her own cubs**. Because these are real articles written for people all over the world, the reading level might challenge you. Feel free to use the **online dictionary** or one in your classroom.

1. Background: Read Information that Started the Scandal

- A third of the people on your team should read: **Lost Cause: exposing abuses of Shanghai's orphans** from the China Rights Forum, Spring 1996. This long article gives background on the history of employees' efforts to improve conditions for orphans at the Shanghai Children's Welfare Institute.
- A third of the people on your team should read: **Death by Default: A Policy of Fatal Neglect in China's State Orphanages**. You can divide it up and have experts on each section or read it together.
- Another third of the people on your team should read: **The Dying Rooms**: a transcript from the documentary. This also is a longer file. You can read it together aloud and take certain parts like a play

or individually read the whole documentary. Either way, it makes sense to print the article out, rather than read from the computer.

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2. Looking Deeper: Different Perspectives on the Topic

You will divide into three different groups that will look at the treatment of orphans in China from three different perspectives.

Instructions:

1. Individuals or pairs from your larger WebQuest team should choose to explore one of the three groups below.
2. Read through the files linked to your group. If you print out the files, underline the passages that you feel are the most important. If you look at the files on the computer, copy sections you feel are important by dragging the mouse across the passage and them pasting it into another program.
3. **Note:** Remember to write down or copy/paste the URL of the file you take the passage from so you can quickly go back to it if you need to to prove your point.
4. Be prepared to focus what you've learned into one main opinion that you hold after reading all the files in your section.

Group One: "Fact Sheets"

- **CNN Interactive News Brief and Photo**
- **Fact Sheet #1: Orphanages in China**
- **Fact Sheet #2: Shanghai Children's Welfare Institute**
- **America's Children: How Are They Doing?**

Group Two: The Chinese Response

- **Response of Chinese Embassy to the Film 'Return to the Dying Rooms'**
- **Children's Institute Denies Abuse Claims**
- **Life and Death in Shanghai: China Lashes Out at a Human Rights Report**

Group Three: China's One Child Policy and its Impact

- **Where 'Quality Control' Leads to Child Murder**
- **Saving The Orphans: ...Worries That Beijing May Close The Doors To Adoptions**
- **Rights of the Child: from China Rights Forum**
- **Little Emperors: Is China's One-Child Policy Creating a Society of Brats?**

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3. Debate and Discuss What You Learned

In case you haven't guessed already from the files you read, the truth about this topic is pretty complex - a lot of people have different opinions about how orphans are treated in China. But remember, your team's job is not to let the paper (like newspapers, fact sheets, transcripts, articles, etc.) cover the burning truth. So now you have to come together with your team and see what you all believe.

Use guidelines for **consensus decision making** to help your team reach a shared decision. Because the topic is so complex with different sides basically calling the other liars, you will have to examine the details of the passages your underlined or copied, the source of the information, and whether any other file gives better evidence on the same issue.

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4. Mail Your Opinions to the World

Once your team has reached its consensus decision about the situation of orphans in China, it's time to send your ideas out into the world. Decide among your team members which of the three people you will each send a letter to. You can can send more than one letter to one of the sites as long as letters are sent to all three locations.

Write Your Congressional Representaives

- Use one or all of the following links to help you find out about your representatives and how to contact them. If possible get both email and snail mail addresses.
- **Zip To It** is a handy way to contact members of the U.S. Congress. Note the email address so you can use it later. Click on their names to go to their personal Web sites and learn more about them.
- **Congressional Quarterly's "On the Job"** let's you find out a lot about your congressional representatives. When you get to the homepage of one of your congresspeople, click on **Profile of Member** to learn about them and get their email or snail mail address.

Write a Human Rights Posting page

One World has been judged "the best non-commercial Web site in the UK" (United Kingdom). It offers news, information, arts, education, and direct action links to support human rights, health, and dignity around the world. You can post your opinion on their **Feedback page** for all the world to see.

Write the President of the United States

The White House maintains a very popular and informative Web site. One feature is that you can **E-mail the President**. Please understand that you are communicating with the President of the United States; other students have been surprised when something that thought of as a prank was taken very seriously by the FBI and the Secret Service. Use this as an opportunity to really make a positive impact by participating in your government.

Conclusion

The old Chinese proverb says that the **tigress doesn't eat her own cubs**, meaning that even the most vicious animal protects and cares for its children, also meaning that adults who hurt children are worse than beasts of prey. We hope that you have seen that although fire easily burns paper, when that paper bears words and propaganda, the flame must burn bright to shed its light of truth. After exploring this WebQuest with your teammates you have some idea about the complexity of issues between China and Western nations like the United States and Great Britain. Other issues present the same kind of problems: trade, freedom of religion, and China's relations with its neighbors. If you found this interesting, please look into the other activities

linked to the "Searching for China" Website.

Last revised September 16, 1996
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Applications Design Team/Wired Learning
http://www.kn.pacbell.com/wired/China/childquest.html
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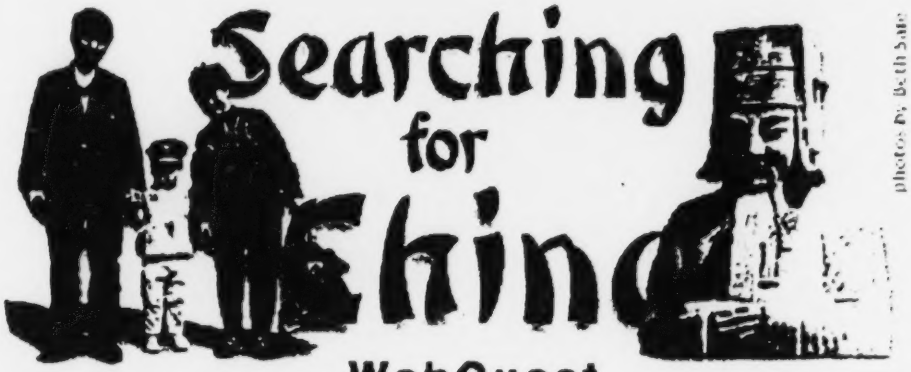
Teaching Guide Internet Links



Visit our series of five other China-related educational Websites.

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Destination CHINA

China is a majestic* country (note: links followed by * go to a dictionary definition) with a long and interesting history. If, like most people in the Occidental* world, you've never been to this fascinating land, you might want to take a brief tour. Go ahead and walk a few kilometers of The Great Wall or step foot into The Forbidden City or voyage to the Yellow Mountains.

But beyond these tourist stops lives another, more complex, China. Currently, the people of China are experiencing great economic and social upheavals*. Such things as the occupation of Tibet, Tiananmen Square massacre, and a scandal about treatment of orphans have brought some people to call for boycotts against China.

Being faced with the task of understanding something as complex as a nation, you might want to give up. Sometimes in life you have that choice. But to give up trying to understand the China would mean giving up chances to benefit financially, to help people, to save some of the world's natural and artistic treasures, to protect the safety and security of millions of people, or to enlighten people's lives with greater religious insight. You see, you can't give up. So, if you're ready to begin, you might want to read a Travel Advisory before embarking* on our journey.

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The Quest(ion) / Task

The United States government feels very strongly about the need to understand China. To do

this effectively, a special fact-finding team is being assembled that will travel to China to investigate the country, the people, and the culture. Instead of sending only diplomats or politicians, the team will comprise* people from very different backgrounds so that the facts they find present as much truth about China as possible. It's hoped that instead of bringing back stereotypes and postcards, the team members will come away with an accurate and informed perspective*.

Specifically, your Quest(ion) is:

What actions should the U.S. take in its policy towards China?

Your team will develop a Group Report that contains a Three Point Action Plan taking into account the following perspectives: Business, Cultural, Religious, Human Rights, Environmental, and Political.

By completing this WebQuest you should achieve the following goals:

- develop an interest in the study of China.
- use the power of the Internet for advanced exploration of China.
- learn information about six key aspects of Chinese culture.
- realize that complex topics can be looked at from various perspectives.
- formulate and support an argument from one of the six perspectives.
- work with your teammates to problem-solve a combined action plan.
- question the nature of international relations in our more interdependent world.

You should be able to achieve these goals by completing a process where you join a team and take on one of the roles listed in the Quest(ion). After each becoming experts on one of the different roles and generating a Full Report, you and your teammates will work together to create a **Group Report** for the American people (also known as your classmates and the World Wide Web community). This report presents your team's combined answer to the Quest(ion). You can use a Rubric to see how your work might be evaluated.

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Background for Everyone

Who are the Chinese people? What makes them tick? Is this as easy a question as it sounds? Think about how difficult it would be for someone to describe you. Are you a person who always acts the same way? Aren't you sometimes happy, sometimes sad? Sometimes friendly, sometimes angry? Sometimes giving, sometimes selfish? Think about groups of people. Wouldn't you expect them to be complex and changing, too? Now think about China with over 1 billion people (more than 4 times the population of the United States!). Is it any wonder that to individuals in the western hemisphere, the Chinese are stereotypically seen as inscrutable*? But we won't fall into stereotypes, because the gig idea behind this WebQuest is that nothing is inscrutable if you look long and hard enough. So where do we begin our Search for China...?

The Journey of a Thousand Miles...

... begins with just one step. And we will begin here. Our minds work better when they are ready to take in new information: no matter how many maps you have, if you haven't turned on the light, you'll still be in the dark. Your mind is that light. So the first activity is a short one to help you and your teammates get a better understanding of the key issues involving China (and to know your teammates better). Click on the link below to go to the activity.

CHINA ?

Exploring Chinese Issues

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Individual Roles

Because China is a complex country, it would be silly to look at it from only one perspective. If you only looked at its art, you might miss its changing politics. If you only looked at its government, you might miss important aspects of the people themselves. So the plan here is to divide expertise and look from as many perspectives as you have teammates. This is where you really begin Searching for China. Read the following instructions to get underway.

.ooking at Issues from Different Perspectives

Based upon the eight main issues your team clustered, now choose which roles you will each take. Use the goal statements below to help you decide.

Note: If you have six people on your team, you can each take one role (or if you work in pairs, up to 12 people can be on one team). If you have less than six people on your team, you will have to choose the roles that you think would give you the best understanding. Will you choose similar roles or very different ones? You decide.

Role	Goal
Business Investor	to promote economic growth
Museum Curator	to preserve the world's cultural treasures
Religious Leader	to encourage spiritual understanding
Human Rights Activist	to ensure that people are treated with fairness
Environmental Activist	to protect the earth's natural resources
United States Senator	to balance all the goals and keep world peace

Now that you have chosen which roles you and your teammates will take, you're ready to become an expert. Dossiers* have been prepared for each role. These contain guided instructions that should help you gain a clear understanding of the issues involved in your role.

Finally each dossier helps you discover some "truths" and to create an Action Plan that will be automatically formatted into your own customized report (**note:** To have the report automatically generated your browser must be able to use Javascript).

If you are ready, click on the manilla envelope or role below, then complete the activities in your dossier.

Business Investor

Human Rights Activist

Museum Curator

Environmental Activist

Religious Leader

United States Senator

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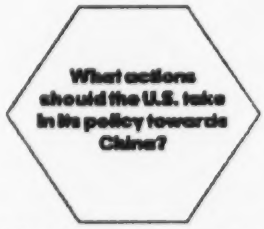
Group Process

Now that each member of your team has become an expert from one perspective, we're ready to combine what each of you has learned into your **Group Report**. This is not easy because you and your teammates each feel you've found the best solution based upon what you feel is most important. But problems come up: what's good for business may not be good for human rights or the environment. What is good for museums is not always good for religious temples. What's good for peace and stability may not be good for business or freedom of speech. Ah-oh! What will you do?

It looks like your team is going to have to dig deeper to come up with a compromise plan that will combine what you all think is important. We know the answer is not easy. That's because the questions are real! In the following group activity, you and your teammates will work through a process to help you find a common Group Report. Click on the link below to go to the activity.



Creating a Group Report

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Real World Feedback

And you thought you were finished! Suggesting the best actions for the U.S. to take in its policy with China took a lot of work. But unless you test your ideas with real people, all you've done is to role-play. You can look for contacts in your school or local community or use the Internet to make a connection. If you decide to find a real world contact from the Internet, you can find all the links used in Searching for China (and more!) in the Website below. Use the instructions below to finish the project.

1. Surf through the links most closely related to the proposals in your Special Report and see if there is a chat, bulletin board, discussion group or e-mail link posted on the Website. (Note: you can also contact your own U.S. senator with ZIP to It).

2. Look for three different places to send your Group Report with its Three Point Action Plan.

3. Double check to make sure your whole group has proofread your Special Report.

4. Write an introduction to your e-mail message that gives background on why you are writing to this particular person and that you'd like to get feedback on your ideas for working constructively with China.

5. Send the report to the three locations. If you are doing this WebQuest in a school setting, use your school's policy for e-mailing, cc'ing teachers, etc.

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Conclusion

We hope that by Searching for China you now appreciate the complexity of international relations, the need to look at challenging questions from different perspectives, and the power of the Internet for making contact with real people. Just to give you something more to think about, sp,e people have might suggest another Quest(ion) related to the U.S. and China: what gives us the right to tell a world power with four times our population what to do? Maybe, because our nation is only 200 years old, we should respect countries that have been around over 20 times longer than we? Maybe, because ours is a democratic system of checks and balances that values individual rights, we have something the world needs to hear? Sounds like this could start another WebQuest, huh?

It's clear, the world is full of complex topics that need sharp-thinking people to understand them and make decisions. There is a saying, "Knowledge is Power." Through your team's activities, you've learned strategies for analyzing complex topics, formulating action plans, and working

together toward effective compromise solutions. We hope you feel this new power that you've gained. What will you do with it?

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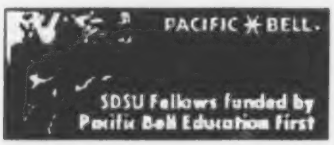

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Applications Design Team/Wired Learning
http://www.kn.pacbell.com/wired/China/ChinaQuest.html
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BRINGING AUTHENTIC SCIENTIFIC INV

Have you spent hours on the Web looking for real science data? The teachers at the Network Montana Project did just that, and they created a Web site with links to a lot of science sites and suggestions for using the information in the classroom. Tim Slater and Brian Beaudrie not only describe this rich resource for K–12 science lessons on the Web, but also detail how to create Web-based science lessons.

By Timothy F. Slater & Brian Beaudrie

Every day, more and more classrooms get access to the World Wide Web. And more and more busy classroom teachers have to figure out how to use this enormous technological resource in their classrooms. The most difficult and critical question for each connected teacher quickly becomes, "I'm online. Now what do I do?"

The Web is a seemingly infinite information resource. Gigabytes of digital images and database information on earth science, physical science, and life science are readily accessible by K–12 teachers and students. Most major federal agencies (e.g., USGS, NOAA, and NASA), global corporations (e.g., CNN, The Weather Channel, Microsoft, and Lockheed-Martin), and colleges and universities have enormous Web sites filled with readily available data, images, resources, and software routines. To use these resources effectively in an educational environment, however, teachers need to create a simple structure for students to navigate. In this article, we describe how the Network Montana Project (NMP) can help K–12 teachers use Web resources to create such a structure and thus support exciting science instruction.

Bringing Real Scientific Investigations to Students

National movements to reform science education emphasize that students should actively conduct scientific investigations rather than passively listen to teachers lecture about science facts. The first part of our job as teacher–facilitators is to expose students to natural phenomena that they can use in making hypotheses, designing and conducting experiments, and justifying conclusions. However, many teachers find teaching by inquiry methods to be initially awkward. And often when students perform investigations, they quickly move into scientific realms far beyond the immediate knowledge of many college professors. An investigative model, however, allows teachers to learn right along with their students.

Scientists pursue the patterns of nature by asking and answering questions. In fact, an investigation and experimentation approach provides one model for bringing scientific investigations into the

NCE ON THE WEB

'ESTIGATIONS TO YOUR CLASSROOM

classroom. This approach mimics the systematic process of scientific inquiry, and instruction occurs in three phases: investigation, experimentation, and extension.

1. ***Investigation.*** During this phase, students look for patterns and potential relationships among natural phenomena or data. Students may work in collaborative groups to share ideas, generate hypotheses, and rearrange data presentations. They work in the same mode as contemporary scientists formulating ideas about manipulated, responding, controlled, relevant, and irrelevant variables for study.

2. ***Experimentation.*** Students formalize a question to address in this phase. They design and conduct a study and then analyze the results using the traditional scientific method. Teams of students answer their own questions rather than investigate the traditional verification and error-analysis problems posed by textbooks. Remember, though, that students who are just beginning to use this model often require guidance and suggestions from a teacher–facilitator. Students may have particular trouble generating answerable scientific questions. The experimentation phase concludes when students report the method and results of their experiment through written, oral, poster, or multimedia presentations.

3. ***Extension.*** Students extend their scientific inquiry by critiquing their own and others' experimental results and by conducting ongoing experiments to identify weaknesses in their

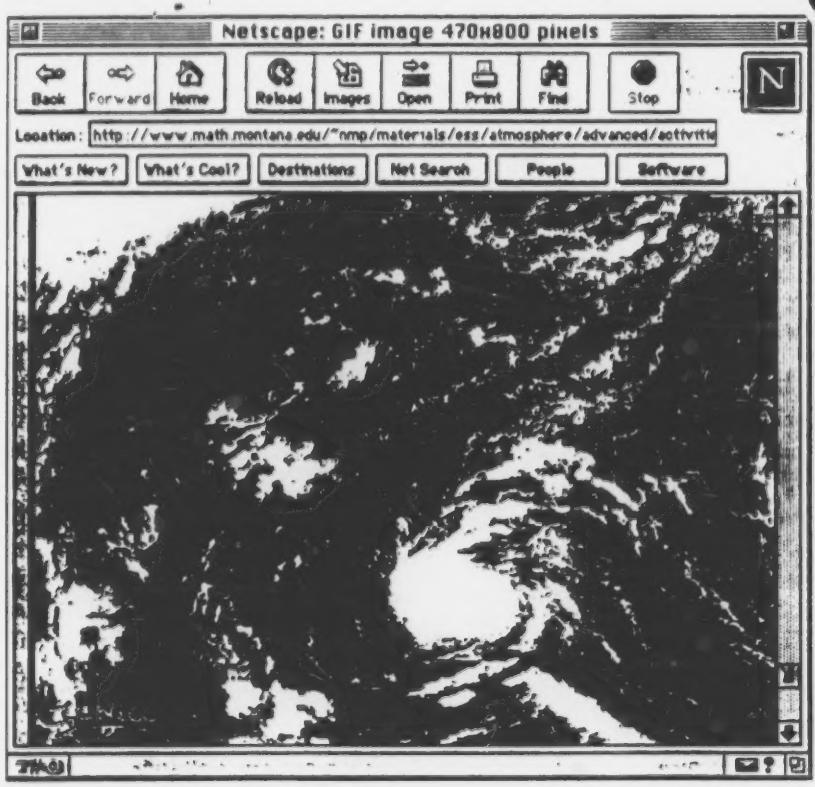

Figure 1. Investigating Hurricane Andrew online.

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METEOROLOGY LESSONS—THE ATMOSPHERE

Novice Level
- Exploration
- Local Weather Data Collection
- Analyzing Weather Data
- Weather Journals & Predications
- Creating a Temperature Map
- Cross-Curricular Connections & Extensions

Intermediate Level
- Tracking a Winter Storm Across the United States
- Tracking a Hurricane
- Extensions and Long-Term Project Ideas

Advanced Level
- Storm Chasing
- Focus on Hurricane Andrew
- Moving Air Masses

Expert Level
- Coriolis Effect
- Global Circulation and Weather Maps
- Weather Tracking and Interpretation

GEOLOGY LESSONS—THE GEOSPHERE

Novice Level
- On Shaking Ground
- Exploding Mountains
- The Layered Earth

Intermediate Level
- Plate Tectonic Puzzle
- The Moving Plates and the Plate Motion Calculator
- Peanut Butter and Jelly—Earth Layers

Advanced Level
- Mountain Building
- Investigation of Hot Spots

Expert Level
- Measuring Volcanoes
- Investigating Earthquakes
- Plate Tectonics Paradigm

OCEANOGRAPHY LESSONS—THE HYDROSPHERE

Novice Level
- Stream Ecosystems
- The Water Cycle

Intermediate Level
- Observing Ocean Colors from Space
- Measuring Global Sea Surface Temperatures
- Strategic Sailboat Racing

Advanced Level
- Dynamic Sea Temperature Studies
- Graphing Ocean Surface Temperatures
- El Niño

Expert Level
- Running Water Analysis
- Exploring Phytoplankton Pigment Concentrations

MOUNTAIN ENVIRONMENT LESSONS

Novice Level
- Classroom Mountain Biomes
- Creating a Contour Map of Your School Playground
- Where Are All the Bears? Where Are the Bears Not?
- Fire in Yellowstone National Park

Intermediate Level
- Life Cycle of a Mountain
- Groundwater: The Hidden Resource
- Monitoring Stream Sedimentation and Water Quality
- The Yellowstone Fires of 1987

Advanced Level
- Rocks and Topography
- Relationships Between Mountain Topology and Precipitation
- Bird Habitat Studies
- Measuring the Earth's Vegetation from Space
- Cryosphere

Expert Level
- Bighorn Sheep
- In Search of Mountain Lions
- Visualization Investigations

Figure 2. A partial list of the online lessons currently available at the Network Montana Project's Web site.

experiments. This phase simulates the ongoing nature of real-world scientific investigations.

This educational model works especially well for lessons that address specific questions about nature. Figure 1, for example, shows a portion of an NMP lesson about Hurricane Andrew. Students are asked to download this and other graphics and then use image-processing software to measure the hurricane's diameter. Students calibrate pixel sizes to measure the hurricane during its different stages. They can also use the images to make movies that show Hurricane Andrew's development. The skills developed during this assignment can be applied to investigation of other weather systems.

This model also works well when students view data that has patterns or attributes that lend themselves to testing predictions and hypotheses. And this model encourages students to formulate and investigate their own questions, especially when they can interact with data from remote locations.

Bringing Real Data to Students

The second part of our job as teacher–facilitators is to help students get real data for use in real investigations. Fortunately, the Web has made this task much easier. We live in an age in which students and teachers believe that they have access to too much information, rather than not enough. The teacher's role now includes helping students manage this deluge of information. One way to approach information management is to limit the sites that students are allowed to visit. This can be done electronically with any one of several software programs.

We believe, however, that a classroom with impassable electronic firewalls only invites trouble. Hard limits do not help students learn how to behave appropriately in an information-rich society. We instead recommend starting with a Web site that has all the information students need and that requires students to be granted permission to leave the site. Efficient information management requires that students have a specific reason for going to the Web and that they go offline to use the information they find. Almost all leading research scientists have one thing in common: They use computers daily to collect data, manage information, and communicate with other scientists. They go online to get the data they need, and then they use the computer offline to analyze and manipulate the data, images, or text. Students can easily follow this model.

Using a Web browser, students can easily gather current images and graphs by simply pointing and clicking a mouse. User-friendly image-processing software is often free to educators and can be used to manipulate images, make calibrated measurements, and animate images into movies quickly. (Two good pieces of software are NIH Image at http://rsb.info.nih.gov for Macintosh and ImagePC at http://www.scioncorp.com for PCs.) Such software is typically

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bundled with computers at purchase or free to download from various Web or FTP sites. Even better, most programs in this realm look and act the same in both Macintosh and PC platforms. In other words, the complicated part of the technology is transparent to the student, inexpensive for the school district, and often looks just like real science done by real scientists. The procedures might even be done the same way at home when parents or siblings access the Web through Internet service providers.

Network Montana Project Curriculum Materials

The most exciting aspect of NMP's Web-based scientific investigations is that students can conduct projects that cannot be supported by textbooks alone. These include "Tracking a Dynamic Winter Storm," "Predicting the Next Hurricane Landfall," "Measuring Global Sea Surface Temperatures," and "Monitoring Current Earthquake Activity." Each investigation uses current data, and one done tomorrow or even later today may bring different results. Real-time data involving students' real-time questions are clearly the most engaging. Such investigations are now possible because of an international commitment to Web data access.

As part of the NMP (funded by the National Science Foundation, NSF RED 9554251), 52 online lessons were created to demonstrate the variety of ways that the Web could be used to conduct scientific investigations at all educational levels. These lessons are freely accessible at http://www.math.montana.edu/~nmp/. Figure 2 is an abridged list of these activities.

These lessons were created by a team of 15 master teachers to demonstrate how the Web could be used in the classroom. Keeping in mind the goal of helping all students conduct scientific investigations, the first task was to identify what Web resources were available. This proved enormously time consuming. The NMP development team started with the principle that students would be most excited about up-to-the-minute scientific data that describes such things as locations of recent earthquakes, current weather radar, and satellite images. The first series of materials was developed by identifying what electronic data and resources were available and easily adaptable for classroom use. The project's teachers then surfed the Web and noted any information that would be useful for in-class scientific investigations. They believed that this was their most important task, because most K–12 teachers do not have the time to identify such resources.

The second task was to identify what national standards and scientific concepts could best be taught using these resources. NMP teams wrote their learning targets in terms of student outcomes. The development team's goal was to create instructional materials that support instruction in ways that textbooks or CD-ROMs cannot—by using current data. Team members always asked themselves, "How is the activity we are developing different from an activity in a textbook?"

The third and final task was to create a set of instructions that would serve as a project interface with the student. In its simplest form, this would be a list of sites for the student to visit and specific data to read or save. A more advanced version would be a Web page with hyperlinks to particular resources as well as directions for using them. Only one year ago, this type of project required programming Web pages in HTML, which can be difficult to master. Today the process is much easier. Many easy-to-use Web-page development programs are available that require little or no HTML programming.

Bringing It All Together

The specific technology needed in your classroom will vary almost as much as the investigations that students can imagine. In general, any machine that can run a Web browser and a word or image processor simultaneously will work, regardless of operating system. Any machine that can handle a PPP or SLIP connection can be used for hypermedia-based instruction. Any Web browser will do, although the most common are Netscape Navigator and Microsoft Internet Explorer. Many Web sites contain special effects that are best viewed with the latest versions of these browsers. Secondary software includes an image processor and a word processor. Other helpful software includes multimedia presentation or development software such as Microsoft PowerPoint, HyperStudio, or Macromedia Director.

Hypermedia lessons provide mechanisms for using current scientific data in constructivist classrooms. These activities can be easily aligned with authentic tasks to conduct actual scientific investigations. Students can check the accuracy of their own weather predictions or analyze seismograms from yesterday's earthquakes. The power of hypermedia has significant ramifications for today's students.

Such instructional activities, however, need to be based on a sound pedagogical foundation. Without such a framework, the resources can become nothing more than "gee-whiz" science exhibits. Most important, though, using the Web to conduct student investigations provides all students with equal access to the real data being used by real scientists right now. ■

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NEW ADVENTURES IN HANDS-ON AND FAR-OUT PHYSICS

Bob and George introduce their new C-TEC project "Hands-On and Far-Out Physics" and outline some of the technology-related activities that they will be working on with high and middle school science and math students this year.

By Bob Albrecht and George Firedrake

Another school year brings another adventure in learning and another opportunity to share our explorations with you in *Learning and Leading With Technology*. Thanks to Dave Moursund, Anita Best, and the others who make *L&L* happen.

We like the way *L&L* is growing, changing, and intertwingling with the Internet. For example, the use of online supplements that enrich articles. The excellent article, "The Spreadsheet—Absolutely Elementary!" by Elizabeth Dudley Holmes (May 1997 issue) is greatly enriched by two online supplements that provide detailed step-by-step instructions for creating the spreadsheets and posters described in the article. Try 'em—we think you'll like 'em. Below we show Web addresses and page references in bold face type:

1. Send your Web browser to L&L's Web site at **http://www.iste.org/publish/learning.**
2. Scroll on down and click **Online article supplements.**
3. Meander down and click either of these online supplement references:
   - Spreadsheet Templates in ClarisWorks Draw
   - How Many Are Going to St. Ives?

Another school year for us brings another year of mentoring at C-TEC, a project-based learning community at Piner High School in Santa Rosa, CA. This year we're starting a new project called "Hands-On and Far-Out Physics," described down yonder in this column.

This episode of Power Tools for Math & Science mentions several Web sites, so check out the online supplement to this article, where you can click site links to send your Web browser exploring.

In the **Online article supplements** page, click **Hands-On and Far-Out Physics.**

Power Tools

Carpenters, electricians, and plumbers use power tools to help them get their work done quickly. Look around your kitchen and count the power tools that help you turn raw materials into culinary delights. A computer and the right software is a great power tool, a great toy—and sometimes both. As Bernie de Koven said, "When tools become toys, then work becomes play."

This column is about using computer power tools in math and science tasks, investigations, and projects—tools that help learners learn and teachers teach. We use the following power tools quite a lot:

- ***Integrated Software Packages.*** Microsoft Office (Word, Excel, et cetera) running in Windows '95. At C-TEC, students and teachers use Microsoft Office on a network.
- ***The Internet.*** Including America Online and assorted search engines. C-TEC uses Netscape and Microsoft Internet Explorer on a local server.
- ***Graphing Calculators.*** Texas Instruments TI-82 and TI-83, both terrific tools for math and science. C-TEC encourages students to acquire their own graphing calculators. Graphing calculators are available in some classrooms and the school library plans to provide a few TI-83s for student use. Later in this column we'll list some Net resources for the TI graphing calculators.
- ***Calculator-Based Lab (CBL) and Microcomputer-Based Lab (MBL).*** Running experiments and grabbing experimental data by using this equipment in real time is a great way to learn and teach. The CBL and MBL are hands-on motivators for sure! Later in this column we'll list some Net resources for CBL and MBL.

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Hands-On and Far-Out Physics

C-TEC is a project-based school. Ninth graders take an integrated science course in which they work in teams on six projects, each lasting five or six weeks. Sophomores, juniors, and most seniors are members of year-long project teams. In May, students choose projects for the next school year. This year we'll work with math teacher Paul Davis to develop and run Hands-On and Far-Out Physics. To sell this project to students, we circulated an ad in the hope that students would become interested and enroll. Here are excerpts from the ad:

- Get a big head start on college physics! Learning how to survive and thrive in college physics is a major goal of the Hands-On and Far-Out Physics project. Another goal is to have fun and enjoy physics.
- Run classical physics experiments, including some you are likely to encounter in first-semester college physics.
- Design and run original experiments—your own experiments.
- Build clever and inexpensive apparatuses for running experiments. Be creative!
- Learn how to use up-to-date real-world equipment for grabbing experimental data, including microcomputer-based lab (MBL) and calculator-based lab (CBL) equipment.
- Use power tools to process experimental data and build mathematical models that fit the data.
- Apply physics to a real-world application. Some possibilities include human habitats on Earth and elsewhere, such as Mars; transportation on Earth and beyond; physics and life sciences; physics and sports; and other things we didn't think of and hope you will.
- Far-out physics is about astronomy and cosmology. We'll use *Cosmos*, Carl Sagan's great book and videos, as a primary resource, and do hands-on work with local astronomers.
- Take cool stuff to middle schools and share the fun with kids and teachers.
- Help develop Hands-On and Far-Out Physics instructional stuff and publish it on the Web.

Year-long projects at C-TEC are allotted the same amount of in-school time as, say, a math or science course. We expect students to invest additional time outside of school. During their outside time, students might take an excursion to a nearby mountaintop observatory, for instance, where the team can have hands-on experiences with a 40" telescope and other neat astronomical equipment, work with astronomers, and gather real-universe data to process. A skateboard park across the street from Piner High School is also a handy site for—well, let's call them motion experiments!

Students will begin the year with fundamental stuff such as mass, length, and time, and do some fundamental measurements. Then we'll measure derived quantities such as area, volume, density, and speed. Everything in metric, of course, and with careful attention to units, significant digits, errors of measurement, and good lab methods. Next we'll run some classical experiments in classical ways, then run 'em again using up-to-date measuring tools such as stopwatches, a CBL, and a MBL.

Galileo and Newton: The Foundation of Hands-On Physics

Classical experiments? A great place to start is to replicate some of Galileo's experiments that ended the domination of Aristotelian science and paved the way for Newton's great conceptual leap. We'll do it with historical perspective in our never-ending quest to intertwingle the disciplines in science, math, humanities, and technology, not necessarily in that order. This task became much easier when we discovered Rice University's **Galileo Project** on the Web. It will be a primary resource in developing and doing Hands-On and Far-Out Physics. Send your Web browser to

http://es.rice.edu/ES/humsoc/Galileo/index.html/.

This site reports on Rice University history students who are replicating some of Galileo's experiments. Students in a history course doing science and math? Bravo! Figure 1 is a snippet from the Student Work section of the Galileo Project, located at:

http://es.rice.edu/ES/humsoc/Galileo/Student Work/.

This is a collection of the semester projects from HIST 333: Galileo in Context. For this course, Professor Van Helden requires his students to divide into groups and complete group projects which are published as World Wide Web documents as well as through traditional oral presentations.

Astronomy

Spring 1995—Undertook a series of observations using telescopes of similar imaging quality to Galileo's.

Spring 1996—Sought to reproduce Galileo's astronomical findings.

Experiments

Spring 1995—Duplicated Galileo's pendulum, parabola, and inclined experiments.

Spring 1996—Reproduced Galileo's experiments with inclined planes and musical pitch.

Trial

Spring 1995—A comical and interesting view of Galileo's subjection to the Inquisition.

Spring 1996—An overview of the Medieval, Spanish, and Roman inquisitions.

Florence

Spring 1996—A cultural, geographical, and historical tour of Renaissance Florence and Tuscany.

Figure 1. Information from the Student Work section of the Galileo Project.

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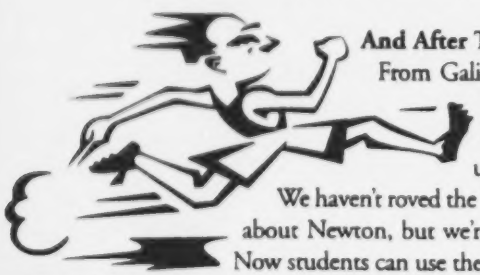
Using Simple Equipment and Modern Power Tools to Model Galileo's Experiments

Galileo did hands-on and far-out physics using rudimentary equipment. How do you measure time without a stopwatch or even a clock with a second hand? Galileo used his resting pulse rate, musical rhythm and tempo, and a clepsydra (waterclock). Sure, we'll have students use their pulse rates to time some experiments. Average speed of someone walking, for example. Of course, students who have different pulse rates will get different values for the same experiment. Aha! We need a device to measure time that doesn't vary from student to student. The Galileo Project describes in meticulous detail how to make a clepsydra and presents spreadsheet data from the students' work. We'll have our project students check out the Galileo Project students' data after they make their first water clock and experiment with it a bit.

Hands-on physics: we'll replicate Galileo's inclined plane, projectile motion (parabola), and pendulum experiments as described at the Galileo Project Net site. Later we'll do these experiments again using modern data capture, including stopwatches, CBL, MBL, and perhaps video data capture.

Far-out physics: It will be fun to do some of Galileo's astronomy experiments. With clear skies, we can rediscover Jupiter's four large moons (known as the Galilean moons), map Earth's moon, see Venus go through phases, et cetera, et cetera. Simple optics experiments will prepare the way for students to construct a Galilean telescope as described in great detail in the Galileo Project site.

We'll add a bunch of rotational motion experiments. First we'll do them as Galileo might have. Then we'll do them again using, say, technology of Newton's time (clocks, for example), then we'll do them again using CBL and MBL. We'll roll solid balls, hollow balls, solid cylinders, and hollow cylinders down an inclined plane, grab data, and use power tools such as the TI-83 and Excel to fit functions to the data. Suppose you have two inclined planes, one of which is frictionless, or nearly so (an air table is a good approximation). Slide a mass down the frictionless inclined plane and roll a ball down the other. Which object will win the race? We'll do it and find out.



And After That...

From Galileo we'll move on to Newton's three laws of motion and law of universal gravitation. We haven't roved the Net yet for good stuff about Newton, but we're sure it's there. Aha! Now students can use theories to make predictions, then run experiments to gather evidence that supports or refutes the theories. Data-grabbing power tools such as CBL and MBL will simplify this task and allow experimenters to capture accurate data.

Well, if we have time, we'll go really far out and investigate Einstein's special theory of relativity. Paul Hewitt's (1997) *Conceptual Physics*, Third Edition has the right stuff at the right level for this investigation. We're confident that our Web browser can find some special sites to aid in this investigation.

Graphing Calculators and Data Grabbers

The power tools that we need for these experiments are getting smaller, more powerful, and even more portable than ever before. For example, a Texas Instruments TI-83 costs less than $90. You can use these amazing instruments to crunch numbers, define and graph functions, find zeros of functions and solutions to systems of equations, do matrix algebra, and fit functions to data. You can customize your personal power tool by writing your own programs or by downloading programs from a vast reservoir on the Web. You can connect the TI CBL to a TI graphing calculator and grab experimental data in real time, as it is happening. For information about Texas Instruments graphing calculators, send your Web browser scurrying to **The Home Page for TI Calculator Users** at

http://www.ti.com/calc/.

You'll find links to product information, classroom activities, discussion groups, supplementary instructional materials, resources for educators, calculator program archives, math and science associations, and more.

Data grabbers used in schools are generally CBLs and MBLs. They consist of two types of hardware:

1. *Sensors* or *probes* measure physical data as it is happening, in real time. Data being grabbed might be temperature, humidity, light intensity, pH, distance, velocity, force, et cetera, et cetera. A sensor converts the quantity being measured to an electrical signal.

2. A device connected to the sensor tells it what to do and stores the data the sensor is grabbing. This may be a gadget specifically designed for this purpose, such as the CBL, or an interface to a computer, usually attached to the computer's serial port (an MBL).

The CBL is a handheld, battery-powered instrument that connects to a TI graphing calculator. Data-grabbing sensors are attached to the CBL, which is then connected to a graphing calculator (TI-82, TI-83, TI-85, TI-86, or TI-92). A program in the graphing calculator tells the CBL what to do. Data grabbed by the sensor is stored in the graphing calculator and graphed on its display. You can use a hardware and software package called Graph-Link to connect the graphing calculator to a com-

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puter (usually by serial port) and download the data stored in the calculator or upload calculator programs from the computer. Our trusty Web browser tells us that the best source of CBL information is **The TI Calculator-Based Lab** site at

http://www.ti.com/calc/docs/cbl.htm.

An MBL consists of data-grabbing sensors attached to an interface box that is connected to a computer. The interface box must also be connected to a power source, either a 110-volt AC outlet or a battery pack. A program in the computer tells the interface/sensor package what to do. The data being captured is stored in the computer and can be graphed on the computer's display in real time or saved for later use. To process and graph the data, you can use software written specifically for the MBL, or you can use general-purpose power tools such as Excel, Works, or ClarisWorks. Roving here and there on the Net, we've found these sources of MBL information:

- **AccuLab Products Group: SensorNet** at **http://www.sensornet.com**
- **Team Labs: Personal Science Laboratory** at **http://www.teamlabs.com/**
- **Vernier Software** at **http://www.vernier.com**

In the real world, another type of data grabber called a *datalogger* is used to capture data, especially temperature and humidity data. A datalogger is an inexpensive self-contained instrument that grabs and stores data without being connected to another device. It just keeps going and going, doing its task. When you want the data a datalogger has grabbed, you hook it to a computer and download the data. Neat and cheap. Our wandering net-rover has found dataloggers from MadgeTech and Omega that grab temperature and humidity data. Check 'em out:

- **MadgeTech New Products Page** at **http://www.xcity.com/MadgeTech/newprods.htm**
- **Omega NOMAD Datalogger** at **http://207.140.183.8/products/nomad.html**

CBL and MBL technologies are used in lots of schools, but we suspect that dataloggers are relatively unknown. So we'll paraphrase some information from the MadgeTech site:

> The MadgeTech TEMP101 is a $68 battery-powered datalogger that automatically records temperature measurements. Its real-time clock insures that all data is time and date stamped. Its reading rate can range from 1 measurement per 2 seconds to 1 per day. Applications include temperature recording of perishable goods in transit, environmental research, ocean or pond studies, refrigeration, artwork preservation, museum monitoring, agriculture, etc. The TEMP101 can read and save 4096 readings (expandable to 16,535). Its operating range is -40 degrees Celsius to +70 degrees Celsius with an accuracy of ±0.5 to ±1.0 degree Celsius. Battery life is two years. Dimensions: 15mm x 35mm x 54mm. Mass: 25.5 grams. The TEMP101 connects to a serial or RS232C port and is controlled by MadgeTech software running in Windows.

In C-TEC's Hands-On and Far-Out Physics Project, we plan to use two types of data grabbers: the TI CBL and the Team Labs Personal Science Lab (PSL). We don't yet have a datalogger, but we'd sure like to get one and try it. If we do, we'll share with you here in L&L. If you know something we don't know yet, please share with us!

Bob Albrecht, PO Box 1635, Sebastopol, CA 95473-1635; DragonFun@aol.com

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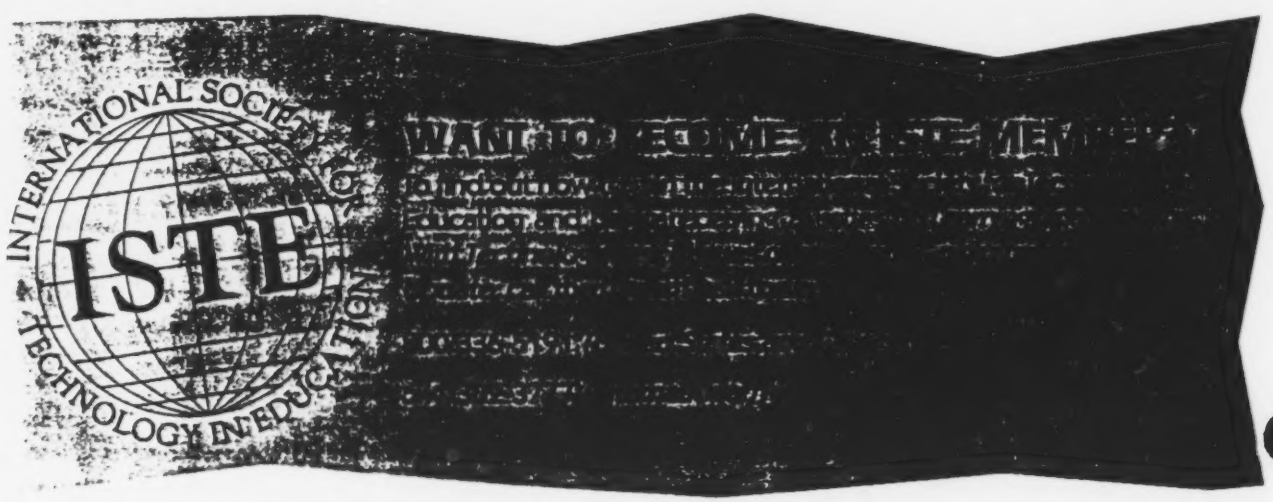

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David Niguidula

Picturing Performance with Digital Portfolios

Much more than an electronic file cabinet, digital portfolios are transforming assessment—and becoming a tool for school reform.

Educators have associated one particular technology with assessment for 60 years: the bubble sheet used with standardized tests. This technology is based on the Markograph, a 1936 invention that reads pencil marks off a piece of paper to compute a score. The bubble sheet has served us well—so well, that standardized tests are a given (Lemann 1995a, Lemann 1995b). In this era of expanding technological capacity, however, it's worth reviewing other technologies to help assess what students know and can do.

For the past few years, a team at the Annenberg Institute for School Reform and the Coalition of Essential Schools, with the support of IBM, has been investigating one such technology—the digital portfolio. Digital Portfolio software is used to create a multimedia collection of student work and connect that work to performance standards. As we've explored this new assessment tool in six schools, we've learned what digital portfolios can do—and what happens in schools that work with them.

School culture is the most critical element in making the digital portfolio a tool for reform rather than a technological version of a set of file folders.

What Is a Digital Portfolio?

The concept for the Digital Portfolio stemmed from the Exhibitions Project, an effort at the Coalition that examined how schools began using authentic assessments in the early 1990s (McDonald 1996). A few of the schools had begun developing paper portfolio systems. But as the folders and file cabinets began to fill, and the paper became supplemented with posters and artwork and video and audio tapes, teachers thought that there had to be a better way to deal with all the "stuff."

Enter the technology. In 1993, as personal computers became capable of capturing audio and video, we developed prototype software for the Exhibitions Project (Niguidula 1993). When it became clear that ordinary mortals, not just computer techie types, could put together multimedia collections of student work, we began to study how such technology could support a school's reform process.

From 1993 to 1996, our team in Providence worked with six Coalition schools: Eastern High School in Middletown, Kentucky; Thayer Junior/Senior High School in Winchester, New Hampshire; University Heights High School in the Bronx, New York; and the three schools of the Croton-Harmon, New York, school district: Carrie E. Tompkins Elementary School, Pierre van Cortlandt Middle School, and Croton-Harmon High School. The sites were rural, suburban, and urban; traditional and alternative; technology-rich and technology-strapped (at least initially). Each school, however, had made a commitment to using portfolios as a regular part of its assessment practice and to providing students with an opportunity to show their skills.

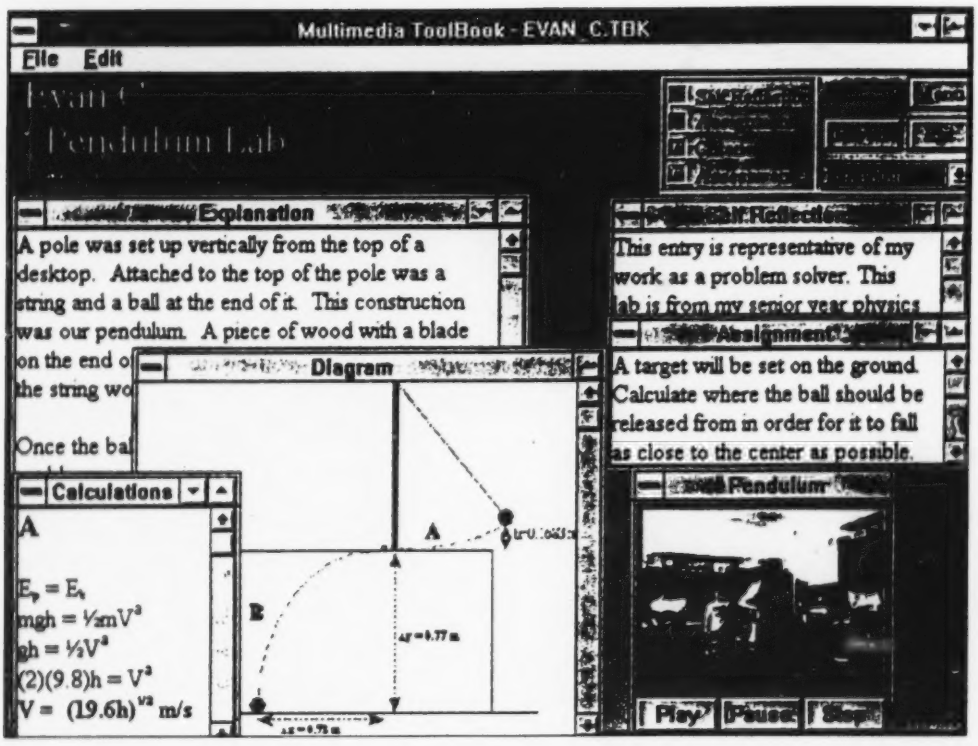
As part of the project, Michelle Riconscente (now at the Center for Children and Technology) and I designed Digital Portfolio software and customized it for each of the schools. We wanted the software to be more than an electronic file cabinet. If a school is going to the effort of putting student work online, the process should add some value to the information. Let's look at how those features are integrated into a student's portfolio.

A Walk Through a Digital Portfolio

The main menu of Digital Portfolio contains a set of goals that represents the school's vision of what a student should know and be able to do. University Heights High School, for example, established seven domains students must master to graduate, including "communicating, crafting, and reflecting" and "knowing and respecting myself and others."

A user can examine a student's portfolio by clicking on one of the buttons in the main menu. That click leads to a list of portfolio entries that the student (typically in consultation with faculty members) has decided best demonstrates his or her ability to meet that goal.

Users who click on a particular entry will see the student work on the left side of the screen. This distra-


Multimedia ToolBook - EVAN_C.TBK
File Edit
Pendulum Lab
Explanation
A pole was set up vertically from the top of a desktop. Attached to the top of the pole was a string and a ball at the end of it. This construction was our pendulum. A piece of wood with a blade
Reflection
This entry is representative of my work as a problem solver. This lab is from my senior year physics
Assignment
A target will be set on the ground. Calculate where the ball should be released from in order for it to fall as close to the center as possible.
Diagram
Calculations
A
$E_p = E_k$
$mgh = \frac{1}{2}mV^2$
$gh = \frac{1}{2}V^2$
$(2)(9.8)h = V^2$
$V = (19.6h)^{1/2}$ m/s
Pendulum
Play
Pause
Stop

may be in several media. For example, the figure above shows a lab report from a Croton-Harmon High School portfolio. The student work includes a description of the lab, a diagram showing how the apparatus was set up, and a video showing the experiment in action. A school could ask students for additional information for each entry, such as the assignment, a self-reflection (describing why this entry belongs in the portfolio), and assessments from teachers or others. A particular entry can be linked to any number of the main menu buttons representing school goals.

What It Takes To Use Digital Portfolios

The addition of technology does not, by itself, change a school. This is especially true for a complex system like the digital portfolio. Without a great deal of planning and reflection about school goals, digital portfolios will become just one more gimmick. For digital portfolios to make a difference in a school, the school must consider multiple systems. We found at least five areas of the school that need to be addressed, and each area poses a set of critical questions.

■ ***Vision***

What should a student know and be able to do?

First and foremost, a school must determine the capabilities its graduates should possess. Nearly all schools compile lists of goals and mission statements, and the standards movement has generated countless documents designed to help schools define their expectations for students. The trick, though, is to make the vision meaningful to the daily life of the school. In the Digital Portfolio software, the vision is translated as the portfolio's main menu. As students and teachers entered work into their portfolios, they had to consider how the activities in the classroom corresponded with the school's stated goals.

■ ***Assessment***

How can students demonstrate the school vision?

Why do we collect student work?

What audiences are most important to us?

How do we know what's good?

Quite apart from their use of technology, the schools in the project wrestled with how they assessed student work. For some schools, the primary purpose of collecting student work was for students to evaluate themselves and celebrate their accomplishments. A portfolio in these places was "successful" if it provided an interesting picture of the student and his or her work. Another approach was to use the portfolio as an evaluation tool to demonstrate student achievements against some standards. One school in the project used digital portfolios in its external review to demonstrate that students had accomplished the skills and acquired the knowledge expected of graduates.

As digital portfolios become more commonplace, we can expect that other audiences, ranging from state departments of education to college admissions and placement offices, will become recipients of these portfolios. Still, the primary audience will remain students and teachers. As the audiences for portfolios expand, so will the conversation about what kind of work is acceptable.

■ ***Technology***

What hardware, software, and networking will we need?

Who are the primary users of the equipment?

Who will support the system?

While the technology is the most visible component of the Digital Port-

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folio system, the effectiveness of the equipment goes beyond the reliability of the hardware and software. In the project, schools used different configurations of equipment. The most effective configuration was one that reflected how the school operates and considered where students and teachers already gather. At University Heights, where students and teachers spend most of their day together as a team (consisting of about 80 students and 3 teachers), each team shared a set of six computers, at least one of which had multimedia input capabilities, a scanner, and a laser printer. In other schools, sets of 5 to 15 machines were designated as digital portfolio stations, meaning that they had multimedia capabilities, and were specifically reserved for students working on their portfolios. There is no right way to configure the system; the critical point is that the intended users of the machines can gain access easily.

Technical support for digital portfolios must stem from a schoolwide vision.

In general, putting entries into Digital Portfolio itself did not require a great deal of time. What took time was putting work into digital form in the first place—word processing, scanning, or digitizing audio or video. As the schools discovered, it was easier when students did their original work on a computer (when appropriate).

Technical support is often the overlooked component of a school's technology system. Ideally, a school's computing coordinator can be a champion for digital portfolios, providing enough support and encouragement to teachers and students to help them become excited and comfortable using the technology. At Eastern High School, technology coordinator Scott Horan prepared a class of about 20 students to become the digital portfolio support staff for the rest of the school.

The technology coordinator also needs to see how the digital portfolios fit with the rest of the school, so that the project is not seen as "Mr. or Ms. Techie's Project." The technical support must stem from a schoolwide vision of how technology, and digital portfolios in particular, corresponds with the school's other systems.

■ ***Logistics***

When will information be digitized?

Who will do it?

Who will select the work?

Who will reflect on the work?

Putting portfolios together, digital or paper, requires teacher and student time. Dean Van De Carr and Jan Felt of Pierre van Cortlandt Middle School described the process as "collect, select, reflect, present." Students need to think about what entries they will *collect*, how to *select* those that best convey their abilities, how to *reflect* on what their portfolio means, and how to *present* what they have learned. Similarly, teachers need to be engaged in the process at each step.

Time for reflection is critical. Schools allocated time for reflecting on the portfolios in various ways, including celebrations (such as a special parents' night) or formal presentations (such as a roundtable presentation of a portfolio required for advancement and graduation). Without time for reflection, the digital portfolio might be no different from a paper portfolio filed away in a locked cabinet.

■ ***Culture***

Is the school used to discussing student work?

Is the school open to tuning standards? With whom?

School culture is perhaps the most critical component in making digital portfolios a tool for reform rather than a technological version of a set of file folders. The key elements of a school's culture that make a digital portfolio system work are the relationships within the school, regular discussions of student work, and an openness to examine the school's vision with others outside the school. A few schools in the project presented their vision statements to critical friends in an attempt to tune their standards (much like members of an orchestra tune their

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instruments with one another—see Allen 1994). Exposing a school's vision to scrutiny can be threatening, but tuning standards allows a school to say with confidence to its community that its work and its vision meet expectations.

A Tool for Transformation

The process of school reform is difficult. Today's technology is flexible enough to be used to support any paradigm for education. We hope the digital portfolio is just a first use of multimedia to help schools rethink their systems. When a school community takes student work seriously and allows teachers, students, and others to reflect on what they have done, then digital portfolios have more meaning. ■

Author's note: A CD-ROM on digital portfolios, including samples from the project, case studies from the schools, and tips for getting started with the technology, is available from the Coalition of ssential Schools, One Davol Square, Providence, RI 02903, http://www.ces.brown.edu.

An adaptation of this article will appear in the book *Student Work/Teacher Learning*, edited by David Allen, to be published by Teachers College Press in 1998.

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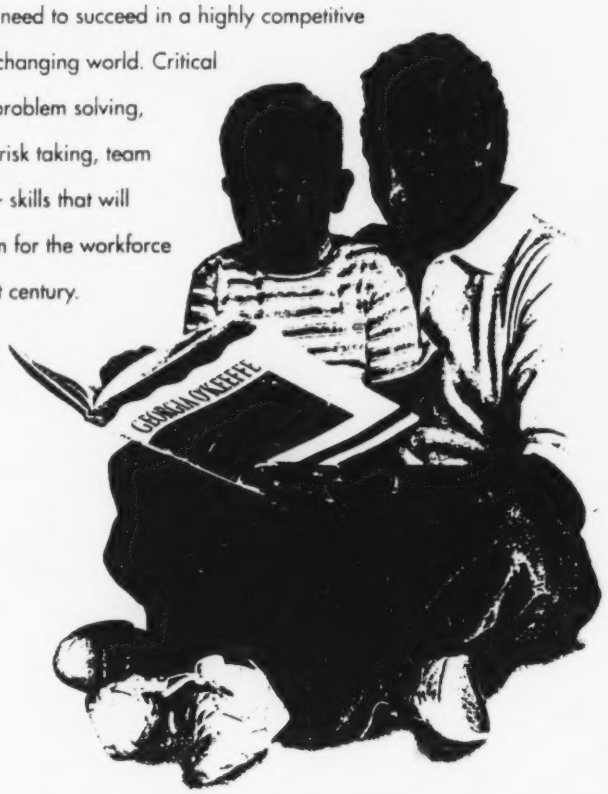

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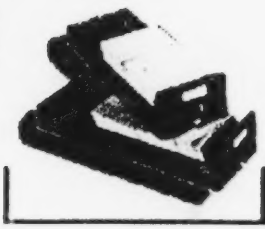

Helping Students Assess Their Thinking

by Richard Paul and Linda Elder

There are two essential dimensions of thinking that students need to master in order to learn how to upgrade their thinking. They need to be able to identify the "parts" of their thinking, and they need to be able to assess their use of these parts of thinking , as follows:

- All reasoning has a purpose.
- All reasoning is an attempt to figure something out, to settle some question, to solve some problem.
- All reasoning is based on assumptions.
- All reasoning is done from some point of view.
- All reasoning is based on data, information, and evidence.
- All reasoning is expressed through, and shaped by, concepts and ideas.
- All reasoning contains inferences by which we draw conclusions and give meaning to data.
- All reasoning leads somewhere, has implications and consequences.

The question can then be raised, "What appropriate intellectual standards do students need to assess the "parts" of their thinking?" There are many standards appropriate to the assessment of thinking as it might occur in this or that context, but some standards are virtually universal (that is, applicable to all thinking): clarity, precision, accuracy, relevance, depth, breadth, and logic.

How well a student is reasoning depends on how well he/she applies these universal standards to the elements (or parts) of thinking.

What follows are some guidelines helpful to students as they work toward developing their reasoning abilities:

1. All reasoning has a **PURPOSE**.
   - Take time to state your purpose clearly.
   - Distinguish your purpose from related purposes.
   - Check periodically to be sure you are still on target.
   - Choose significant and realistic purposes.

2. All reasoning is an attempt to **FIGURE SOMETHING OUT, TO SETTLE SOME QUESTION, TO SOLVE SOME PROBLEM.**
   - Take time to clearly and precisely state the question at issue.
   - Express the question in several ways to clarify its meaning and scope.
   - Break the question into sub questions.
   - Identify if the question has one right answer, is a matter of opinion, or requires reasoning from more than one point of view.

3. All reasoning is based on **ASSUMPTIONS**.
   - Clearly identify your assumptions and determine whether they are justifiable.
   - Consider how your assumptions are shaping your point of view.

4. All reasoning is done from some **POINT OF VIEW**.

- Identify your point of view.
- Seek other points of view and identify their strengths as well as weaknesses.
- Strive to be fair-minded in evaluating all points of view.

5. All reasoning is based on **DATA, INFORMATION and EVIDENCE.**
   - Restrict your claims to those supported by the data you have.
   - Search for information that opposes your position as well as information that supports it.
   - Make sure that all information used is clear, accurate, and relevant to the question at issue.
   - Make sure you have gathered sufficient information.

6. All reasoning is expressed through, and shaped by, **CONCEPTS** and **IDEAS.**
   - Identify key concepts and explain them clearly.
   - Consider alternative concepts or alternative definitions to concepts.
   - Make sure you are using concepts with care and precision.

7. All reasoning contains **INFERENCES** or **INTERPRETATIONS** by which we draw **CONCLUSIONS** and give meaning to data.
   - Infer only what the evidence implies.
   - Check inferences for their consistency with each other.
   - Identify assumptions which lead you to your inferences.

8. All reasoning leads somewhere or has **IMPLICATIONS** and **CONSEQUENCES.**
   - Trace the implications and consequences that follow from your reasoning.
   - Search for negative as well as positive implications.
   - Consider all possible consequences.

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International Center for the the Assessment of Higher Order Thinking

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Sonom State University

Director: Richard Paul, Ph.D., Asst. Director: Linda Elder, Ed.D.
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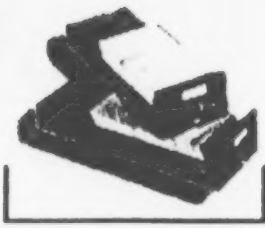

Valuable Intellectual Traits

- **Intellectual Humility**: Having a consciousness of the limits of one's knowledge, including a sensitivity to circumstances in which one's native egocentrism is likely to function self-deceptively; sensitivity to bias, prejudice and limitations of one's viewpoint. Intellectual humility depends on recognizing that one should not claim more than one actually knows. It does not imply spinelessness or submissiveness. It implies the lack of intellectual pretentiousness, boastfulness, or conceit, combined with insight into the logical foundations, or lack of such foundations, of one's beliefs.

- **Intellectual Courage**: Having a consciousness of the need to face and fairly address ideas, beliefs or viewpoints toward which we have strong negative emotions and to which we have not given a serious hearing. This courage is connected with the recognition that ideas considered dangerous or absurd are sometimes rationally justified (in whole or in part) and that conclusions and beliefs inculated in us are sometimes false or misleading. To determine for ourselves which is which, we must not passively and uncritically " accept" what we have " learned." Intellectual courage comes into play here, because inevitably we will come to see some truth in some ideas considered dangerous and absurd, and distortion or falsity in some ideas strongly held in our social group. We need courage to be true to our own thinking in such circumstances. The penalties for non-conformity can be severe.

- **Intellectual Empathy**: Having a consciousness of the need to imaginatively put oneself in the place of others in order to genuinely understand them, which requires the consciousness of our egocentric tendency to identify truth with our immediate perceptions of long-standing thought or belief. This trait correlates with the ability to reconstruct accurately the viewpoints and reasoning of others and to reason from premises, assumptions, and ideas other than our own. This trait also correlates with the willingness to remember occasions when we were wrong in the past despite an intense conviction that we were right, and with the ability to imagine our being similarly deceived in a case-at-hand.

- **Intellectual Integrity**: Recognition of the need to be true to one's own thinking; to be consistent in the intellectual standards one applies; to hold one's self to the same rigorous standards of evidence and proof to which one holds one's antagonists; to practice what one advocates for others; and to honestly admit discrepancies and inconsistencies in one's own thought and action.

- **Intellectual Perseverance**: Having a consciousness of the need to use intellectual insights and truths in spite of difficulties, obstacles, and frustrations; firm adherence to rational principles despite the irrational opposition of others; a sense of the need to struggle with confusion and unsettled questions over an extended period of time to achieve deeper understanding or insight.

- **Faith In Reason**: Confidence that, in the long run, one's own higher interests and those of humankind at large will be best served by giving the freest play to reason, by encouraging people to come to their own conclusions by developing their own rational faculties; faith that, with proper encouragement and cultivation, people can learn to think for themselves, to form rational viewpoints, draw reasonable conclusions, think coherently and logically, persuade each other by reason and

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become reasonable persons, despite the deep-seated obstacles in the native character of the human mind and in society as we know it.

- **Fairmindedness**: Having a consciousness of the need to treat all viewpoints alike, without reference to one's own feelings or vested interests, or the feelings or vested interests of one's friends, community or nation; implies adherence to intellectual standards without reference to one's own advantage or the advantage of one's group.

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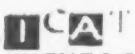

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Sheldon Berman and Robert Tinker

The World's the Limit in the Virtual High School

Combining high-quality instruction and current technology, netcourses in virtual high schools are uniquely able to reach specialized groups of learners—any time and any place.

The instructional potential of the Internet is extraordinary. Yet schools have hardly scratched its surface. With the assistance of a five-year U.S. Department of Education Technology Innovation Challenge Grant, the Hudson (Massachusetts) Public Schools, the Concord Consortium Educational Technology Lab, and 30 collaborating high schools across the nation have begun a bold and far-reaching experiment to realize this potential through the development of a virtual high school over the Internet. Through Internet-based courses, Virtual High School significantly enhances the curricular offerings of each school and integrates the best that technology can offer into the academic curriculum.

Netcourses bring the world into schools by tapping into knowledge and experience anywhere.

Virtual High School is built on a simple concept. Each school in the collaborative selects one or two innovative and technologically adept faculty members to teach over the Internet. These teachers receive training in how to teach netcourses, engage students, maximize the use of Internet-based resources, and utilize the best in multimedia technology. In exchange for releasing each teacher to teach one netcourse, the school is able to register 20 students to take netcourses offered by any of the participating schools. Because the teachers for these 20 students may be in 20 different schools, each school provides release time for a site coordinator who acts as a guidance counselor and technical advisor for students in that school who are taking netcourses.

In the future, our university and corporate partners will also offer courses, at times even for university credit. In this way, we bring the world into schools by tapping the knowledge and experience of corporations, universities, and individuals anywhere. This instructional medium is particularly effective for four types of courses:

1. Advanced courses, including advanced placement courses, advanced electives such as "Modeling and Calculus," or advanced literature courses in any language.

2. Innovative core academic courses that maximize the use of technology, such as "Writing Through Hypertext," a simulations course on "Economics and the Budget Debate," or the "Global Lab" environmental studies course that uses online collaboration among students worldwide.

3. Courses for language minorities, so that small groups of students from a particular language background for whom individual schools are not able to offer a bilingual program can take courses in their native language.

4. Technical courses built around the very technology we are using, such as "Network Operations" and "Robotics."

In September 1997, Virtual High School teachers began offering 29 courses to more than 550 students from 27 high schools. The initial set of courses includes such titles as "Microbiology," "Model United Nations," "Informal Geometry," "Writing through Hypertext," "Business in the 21st Century," "Stellar Astronomy," "Bioethics," "Advanced Placement Statistics," "Economics and the Budget Debate," "Poetics and Poetry for Publications," "Programming in C++," and "Music Composition."

Virtual Classes, Real Benefits

Virtual High School provides four unique benefits for schools and students. First, it significantly expands curricular offerings. For example, many high schools cannot offer advanced or specialized courses because enrollment is too low to economically justify the course. Through netcourses, however, small groups of students at a number of high schools can fill these courses.

Second, it provides technology-rich instruction. Netcourses give students experience in telecollaboration and the use of software tools in the context of serious academic instruction. Netcourses provide learners experience with e-mail, online working groups, and online conferencing. They challenge students to learn how to use the medium to communicate well.

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present data authoritatively, and demonstrate effective research skills.

Third, Virtual High School brings unprecedented resources to schools. Students learn how to access the wealth of data on the Internet. From exploring primary source material at the Library of Congress to accessing scientific databases to conversing with experts, students can take their learning far beyond textbooks into the real world of open-ended problems and unanswered questions.

Finally, Virtual High School significantly enhances teachers' skills in technology that can extend to their regular classroom instruction. There is probably no better way for teachers to become adept at telecollaboration and using a wide range of software tools than to make daily use of them in their instruction.

New Approaches to Instruction

Although netcourses provide unique benefits for education, they are a challenge to organize and teach. Netcourse instruction is different from regular classroom instruction and requires a particular approach to be successful. One cannot simply transfer a traditional course into the Internet environment. A number of netcourse design characteristics that match technology and quality education have emerged:

Asynchronous communication. Netcourses need to make effective use of asynchronous communication that does not require the sender and receiver to be present at the same time. These asynchronous technologies include electronic mail, conferencing, and news groups. Synchronous technologies, such as two-way voice and video, real-time chats, and shared applications, require two or more users to be present at the same time. Asynchronous communication is more adaptable to a person's schedule, works far better across time zones, and usually requires less technology.

Seminar model. Many teachers who experiment with online courses report being overwhelmed with enrollments of only 10 or 12 students because they set up e-mail conversations with each student. The better model is more like a seminar, in which the teacher determines the topic and activities, encourages substantive interactions among students, monitors and shapes the conversation, and promotes an atmosphere in which students respond to one another's work. This model results in more conversation, is far more likely to be constructivist, and builds on the rich learning that takes place in groups.

Technology-rich instruction. Access to the Internet and multimedia computing is a requirement for netcourses. Participants need to utilize all the resources of the Internet—data, images, references, current events, and expertise. Because of the general isolation that a student taking a netcourse may experience, a text-based course will not hold interest. Teachers need to use all available technology resources—including digitized images, short audio and video clips, graphics, conferencing, and multimedia presentations—to bring students in contact with one another

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and the reference world within the network.

Project-based learning. In addition to maximizing the use of technology to engage students, netcourses need to create forms of instruction that actively involve students. Projects that are posted for the whole class, simulations and gaming that involve the class in role-playing, and collaborative investigations are strategies that provide the kind of hands-on engagement that breaks away from the static medium of text-based communication.

Netcourses have some obvious disadvantages as well, the most significant being the lack of face-to-face communication. Interpersonal communication is far richer than electronic communication. Responses are immediate, nonverbal cues enhance communication, and group dynamics become an important part of the message.

The lack of this kind of communication, however, may serve some students well. Often in classrooms, the social dynamics of the group dictates who responds and who is acknowledged. In the rapid-fire exchanges of the classroom, those who think the most quickly are often the most vocal. A netcourse brings freedom from these restraints. Virtual High School students enter a new social environment that does not carry their personal history into each course. It gives students the time to think through an answer and shifts attention from articulate speech to articulate writing and presentation. Netcourses offer opportunities for students to demonstrate unique abilities that they may have not been able to exhibit in the regular classroom.

Photo courtesy of the U.S. Department of Education

Sheldon Berman shows U.S. Secretary of Education Richard Riley and Congressman Marty Meehan (Mass.) how to enter the Virtual High School.

Freedom from Time and Place

Netcourses have a number of built-in advantages compared to traditional courses. The asynchronous communication can be more inclusive than classroom discussions, the seminar model provides for stronger collaborations, and the full use of information technologies gives teachers and students facility in their application.

But one of the greatest advantages is that netcourses can be offered any time and any place. Thus they can reach new audiences, utilize new teachers, and tailor instruction. Homeschooled students, students who are too ill to attend school, and students who live in rural communities can have the same rich curriculum as anyone else. A netcourse faculty can easily be a world-wide team of experts, as netcourses make it feasible for far more people to share their time and knowledge with interested learners. Because netcourses have a global reach, teachers can tailor them to serve learners, from special needs students to language-minority students to students interested in a highly specialized topic. The ability to use new kinds of teachers to reach new, widely scattered and specialized audiences means that netcourses can have an impact both within the traditional structure of the high school and far beyond that structure as well.

Netcourse instruction is different from regular classroom instruction. One cannot simply transfer a traditional course into the Internet environment.

Virtual High School can never replace the experience of being in a positive social learning environment within a school. Yet this project opens a new medium for education that can merge the best in instructional practice with the best in current technology. ■

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School Is Not Enough: Learning for the 21st Century

By John Abbott

SUCCESSFUL PREPARATION OF OUR YOUTH FOR THE 21ST CENTURY WILL REQUIRE NEW MODELS AND UNDERSTANDING OF HOW WE LEARN AND DEVELOP INDEPENDENCE—AND THE INVOLVEMENT OF THE ENTIRE COMMUNITY.

The strategic center of the 21st century has to be individual and group learning. Successful individuals will be those who can direct and manage their own learning as they navigate their way through several careers over the course of a lifetime. Successful companies will be those that can facilitate learning teams, and provide the environment for innovation and creativity. And successful communities will be those that maintain and nurture civil society through developing systems and relationships that help foster lifelong approaches to "learning how to learn," which enable self-sufficiency and the participation of all members in the life of the community.

Humans have been learning to use their brain ever better with each generation over millions of years. There is one exception, and that is what has happened over the last five or six generations. This may at first sight seem a paradox. Until the early 1800s people learned in real life, on-the-job situations. They were essentially inclusive learners—they had to use all their faculties. Then the pressures of an industrial society required people to develop no more than a range of functional skills (such as reading, writing, calculation, etc.) that enabled them to fit into an industrial society—for most people this meant the dull routines of manufacturing industry. The more inclusive skills that enabled people to make sense of things for themselves in earlier ages were largely ignored.

Humans have been learning to use their brain ever better with each generation over millions of years [with] one exception.

Formal schooling as we know it is largely the creation of the last 100 or so years. Its achievements have been immense, and it has been widely replicated around the world. Yet, for all its achievements, it is eventually limited by the technology of the classroom, formal instruction, uniform stages of progression, prescribed knowledge, a curriculum of self-contained bits and the fact that no child in Western Society spends more than 20 ercent of his or her waking hours in a classroom.

Holding on to the belief that learning and schooling are largely synonymous is severely inhibiting our ability to prepare for the opportunities and challenges of a true global economy.

Fortunately, a new model of learning is emerging based on current understandings about the brain, about human intelligence, and about human memory. This is coming out of cognitive science, neurology, evolutionary biology/psychology, cultural anthropology (even from archeology), as well as pedagogy, conventional psychology and systems theory. In addition to these new understandings, radical developments within information and communication technologies are beginning to change how young people acquire the information they need to build knowledge, and develop the abilities to meet the challenges and opportunities of the Knowledge Age.

The belief that learning and schooling are largely synonymous is severely inhibiting our ability to prepare for...a true global economy.

Medical and cognitive sciences, new technologies and a vast array of pedagogic research are helping us to appreciate far more about just how the brain works. The brain is, literally, the most complex living organism in the Universe (some call it "The Cathedral of Complexity").[1] Although it weighs only about three pounds, it is made up of approximately one million, million cells. By way of illustration, that is roughly all the stars in all the galaxies in all the universe. The total length of the "wiring" between the neurons is roughly about one hundred-thousand kilometers. Professor Susan Greenfield, when lecturing a group of fourteen year olds, at the Royal Institution in London, compared their memory capability with that of a thousand CD ROMs, each one containing an entire Encarta Encyclopedia.

While it is essential for scientists to understand the molecular details of brain chemistry, for all practical purposes it is the science of complexity that enables us to make greater sense of the numerous layers of organization within the brain that act together, apparently miraculously, to handle not only memory, but also vision, learning, emotion and consciousness.

The human brain, in all its structures and processes, is a direct response to the complexity of the interaction of all those factors in the environment that man has had "to know what to do about" since the beginning of time. Until about half a million years ago the brain changed through evolution but very slowly.

Our brains then started to grow more rapidly as we learned to use language. It has only been within the last 30–60 thousand years, that we have developed the capacity to be "broadly intelligent."

What does that mean? Archaeology, as well as Cultural Anthropology, is starting to show that while humans have developed a number of discreet skills over a million or so years (social intelligence, technological intelligence, natural history intelligence, language intelligence, etc.) it is only recently that we have been able to combine these intelligences to create that broad intelligence which now gives us our amazing versatility. The cave paintings discovered at Chauvet, in France, in 1994, date exactly from this period of 30 thousand years ago. They are highly sophisticated and represent the coming together of social, technological, and natural history intelligence. They seem, as it were, to have leapt out of nothing. We know of no "primitive art" that preceded it—probably there wasn't any. With the emergence of broad intelligence, modern man came to be.[3] Archaeology is starting to endorse Howard Gardner's call to educationalists to work with all of children's many forms of intelligence. That is what gives us our creativity.

It is only recently that we have been able to combine these intelligences to create that broad intelligence which now gives us our amazing versatility.

The brain is adept at handling a variety of situations simultaneously; historical facts are fitted into mathematical patterning when the brain is comfortably challenged, within a non-threatening situation. Psychologists and cognitive scientists call this a state of "flow:" a state reached when a person becomes so engaged in what he or she is doing that all tasks seem within one's capability.[4] It is that which makes it possible for each of us to react, moment by moment, to our immediate environment while also thinking about a number of abstract matters. The brain handles this complexity through several layers of self-organization whereby vast interconnecting networks are established. It is as if the brain is constantly "re-tooling itself" to work effectively in new and emerging situations. Once established, traces of these networks appear to survive almost indefinitely, and are frequently used as solutions to new problems. It is these earlier traces that give the brain its ability to build new ideas.

Neurologists are now beginning to see some forms of memory in operation (i.e., they can literally watch specific patterns of activity within the brain light up on a computer screen as a result of Functional MRI and PET Scans). To the researchers' surprise, memory does not exist in just one, but many, locations in the brain. Some people compare memory to a hologram where the whole exists in all the parts. Memory traces seem to follow those neural-networks that the individuals—at the time of original thought—found most to their advantage. The neural-network might have been activated for only a short time, and designed for a specific purpose that is no longer applicable, and may well cross many "domains," but even when that route is no longer needed, a trace of its past activity is still present. Nothing, it seems, is ever irretrievably "lost," though just now it is that we can access memory more effectively at some stages than at others still eludes us. If part of the network is later activated, it may well "question" why it is not being asked to complete the original set of connections.

Archaeology is starting to endorse Howard Gardner's call to educationalists to work with all of children's many forms of intelligence.

All this is done spontaneously in response to challenge. The brain does not have to be taught to learn. Learning is what it does—automatically. To thrive, the brain needs plenty of stimulation, and it needs suitable feedback systems. Effective learning is dependent upon emotional energy. We are driven (the ancestral urges of long ago) as much by emotion as by logic. Children who learn because they simply want to work something out because it matters to them, are far more resilient and determined when they face problems than children who seek external rewards. The same goes for adults. Intrinsic motivation is far more significant than extrinsic. When in trouble the first group searches for novel solutions, while the latter looks for external causes to blame for their failure. The brain is essentially a survival system, it takes seriously those things that matter to it. Emotional well-being may well be more essential—to the brain—for survival, than intellectual.[5]

Too much stimulation, however, at any stage in life, turns a challenge into a threat. The brain deals with this easily. It just "turns off." This is seen, dramatically, with MRI. Give a person a mental task that interests them, and many parts of their brain are seen to "light up." Persistently insult that person and he or she goes into a form of mental defense. The lights literally go out. "Down shifting"—a phenomenon long recognized by psychologists—is a strictly physiological defense mechanism. To work effectively at a challenging task, research is now suggesting, requires among other things significant amounts of reflective activity. "I need to go away and think that over" is a critical part of brain functioning.[6]

Since no two brains are exactly alike, no enriched environment will completely satisfy any two individuals for an extended period of time. No matter what form the enrichment takes it is the challenge that matters; passive observation is not enough, it is interactivity that is so essential. "Tell me and I forget. Show me and I remember. Let me do and I understand," says the ancient Chinese proverb.

"Tell me and I forget. Show me and I remember. Let me do and I understand," says the ancient Chinese proverb.

With these new understandings of the brain, we are now in a far better position to fuse formal learning structures onto natural learning predispositions that extend them "beyond what comes naturally." Simply put, we now know how to make it possible

for people to become better learners. The implications of this for society and for the economy are massive.

The ability to think about your own thinking (metacognition) essential in a world of continuous change. In this way skills can be developed which are genuinely transferrable, and which are not tied to a single body of knowledge. These are linked to a form of intelligence known as reflective intelligence. Some people call this "wits."

Such expertise as implied by wits—the ability to step back as a specialist and honestly re-evaluate what you are doing in terms of a general perspective—is by its very nature, a skill more naturally developed in the rich collaborative problem-solving and uncertain world of the apprentice, than ever it can be in the formal classroom with its inevitable emphasis on tasks, schedules, and measurable activities. Expertise is difficult to achieve without being a specialist, but it is much more that just specialism. It requires the knowledge of much content, and the ability to be able to think about this both in the specific and the abstract. It is essentially that deep reflective capability that helps us break out of set ways of doing things, unseating old assumptions, and setting out new possibilities. It is the essential ability necessary to face a world of economic, social and political transformation.

Just as we are undoubtedly on the brink of new understandings about learning, so too are we beginning to see how radical developments in technology can enhance how young people acquire information and assimilate knowledge. The Internet is encouraging the development of virtual learning communities that are ideas and concepts, develop group understandings, and en incite action.[1] Learning is essentially a social, collaborative, problem-solving activity, and the Internet enables these virtual learning communities to thrive.

Learning is essentially a social, collaborative, problem-solving activity, and the Internet enables these virtual learning communities to thrive.

Information and communication technology can enhance human learning because we form our own understandings through a multiplicity of interactions, and draw continuously upon the thinking of countless earlier generations. Such learning arrangements as offered by information and communication technology are highly compatible with the natural functioning of the brain, with what we know about human aspirations, and in particular what is now known about the adolescent's need to feel involved and of value.

Conclusion

A model of learning that could deliver real expertise—abilities acquired through effort that carry us beyond what nature has specifically prepared us to do—could be ours now for the ask-

It would work on the basis of the biological concept of weaning...giving young children all the possible help they might need when they are very young, and then reducing this progressively as the young master more and more skills. Thus, as adolescence ends, the young person has already taken full responsibility for managing and directing his or her own learning. The age of 18 should not be the age at which people start to become independent learners, but the age when they demonstrate that they have already perfected that art, and know how to exercise this responsibly.

Formal schooling, therefore, has to start a dynamic process through which pupils are progressively weaned from their dependence on teachers and institutions. They are given the confidence

The 21st Century Learning Initiative

The 21st Century Learning Initiative is a transnational program to synthesize the best of research and development into the nature of human learning. Its purpose is to inform and stimulate public debate on how this can be used to improve education, work and the development of communities worldwide.

Mounting evidence worldwide suggests that traditional education systems are increasingly becoming dysfunctional in the face of escalating technological, social, and economic change. Profound questions are being asked as to why so many young people seem so ill-prepared for work or for participation in civil society.

Daunting as these issues are, a growing number of world-class researchers, educational innovators, thinkers, and policymakers from several countries, together with concerned funders, believe solutions await development and have started to meet under the auspices of this Initiative. They are convinced that change can and will take place if they take collective action to exploit new insights emerging from an increasing array of research into just how it is that people learn-how-to-learn (and thereby develop real understanding and transferrable skills), and then link these findings with the experience gained from successful and innovative practices worldwide.

The Initiative, registered in June 1996 as a nonprofit U.S. organization, was initially set up by the Education 2000 Trust in the United Kingdom with key support from The Johnson Foundation and several anonymous funders in the United States.

The Initiative, having completed its first stage by formalizing its membership and completing the initial Synthesis document on human learning, is now preparing for its critical second stage that will consist of three components: the sharing the Synthesis document on human learning [illegible] the promotion and dissemination of the research, concepts, and essential Innovations outlined in the Synthesis [illegible] the policy and grassroots level. Linking Research to Practice is about the forging of partnerships with practitioners and policymakers at all levels who are already trying to transform their communities and education systems. Developing the concepts and research base within the Synthesis is crucial for maintaining its authenticity. This third component [illegible] accomplished through a process of review and discussion with experts to permit the Synthesis to be updated [illegible] with the most relevant new findings about the nature of human learning from sources worldwide.

For more information on the Initiative [illegible] <holt@clerols.com>, telephone 202-862-1698, or [illegible] 202-862-1699.

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John Abbott directs The Education 2000 Trust, a British not-for-profit that links leaders from education, industry, and the social sector on behalf of "whole systems change" in education. He came to fame in England as the young head of the 16th Century Alleyne's School, which he developed into an all-ability school for 900 boys and at which he set up England's first computerized classroom. Since early 1996, Abbott has been in Washington, DC, leading The 21st Century Learning Initiative (see page 31).

to manage their own learning, collaborate with colleagues as appropriate, and use a range of resources and learning situations.

To achieve this, the formal school system and its current use of resources has to be completely re-appraised, and effectively turned upside down and inside out. Early years learning matters enormously; so does a generous provision of learning resources. If the youngest children are progressively shown that a lesson about learning something can also be made into a lesson about how to "learn-how-to-learn" and remember something, then the child, as he or she becomes older, starts to become his or her own teacher. In industrial terms, the child ceases to be totally dependent on the teacher as an external force, and progressively becomes part of the "learning productivity process." The older the child becomes, the more the child as a learner becomes a resource that the community has to come to value.

By reversing staffing ratios, creating smaller classes, and providing the best teachers in the early years of elementary education (developing as a matter of course a very particular style of education), children would be provided with an ever-richer array of learning resources as they get older. The Knowledge Age by its very nature represents an increasing dispersion of knowledge at all levels of society and within all organizations. Therefore, if adolescents are to develop the skills and attitudes necessary for a knowledge economy, it is essential to view learning as a total community responsibility. It is certainly not just teachers who must teach nor students who must continually learn, and it is not just the classroom that is the major access point to a range of information and expertise on which knowledge is built.

Good schools alone will never be good enough. Successful societies in the 21st century will have learning communities that are in-line with the needs of a continuously changing economic and social environment. ◄

This article was based on the work of The 21st Century Learning Initiative. Special thanks are extended to my assistant Terence Ryan for his help in writing this article.

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Vicki Hancock

Creating the Information Age School

Six schools that demonstrate the characteristics of an Information Age school provide insights into what educators must do to give students the skills they need to succeed in the workplace and the community.

Most school-age children in the United States interact every day with a variety of information media—television, video games, multimedia computer systems, audio- and videotape, compact discs, and print. At the same time, workplaces are retooling with advanced technologies and acquiring access to complex, comprehensive information systems to streamline operations. Our youth have so much exposure to technological gadgets and information resources that one would think the transition from school to workplace would be second nature. Not so. According to recent projections, only about 22 percent of people currently entering the labor market possess the technology skills that will be required for 60 percent of new jobs in the year 2000 (Zuckerman 1994).

To eliminate this mismatch between schools and workplace, we need "Information Age" schools. But what does an Information Age school look like, and how do you begin to create such a school?

What It Looks Like

Researchers (Breivik and Senn 1994, Glennan and Melmed 1996, Cuban 1997) point to at least six attributes that characterize an Information Age school. The following descriptions of these attributes include examples of exemplary schools, along with contact information. I have "found" each of the schools by making site visits in my former role as an ASCD regional director and by serving as a judge in a variety of technology competitions.

Interactivity. In schools demonstrating interactivity, students communicate with other students through formal presentations, cooperative learning activities, and informal dialogue. Students and teachers talk to one another about their learning tasks in large groups, small groups, and one-to-one. Students have constant access to and know how to use print and electronic information resources to inform their learning activities. They recognize the value of the information in their own communities and interact with various community members, including businesspeople, social service staff, arts professionals, athletes, older adults, and volunteer workers, enhancing their curriculum studies with authentic information from primary sources.

At the Sun Valley Elementary School in Winnipeg, Manitoba, 4th grade students regularly participate in "keypals" activities to exchange cultural information with schools around the world. Students in grades 5 and 6 use resources from their school and community to develop "talking books" that provide graphic, textual, and auditory lessons on animals, foods, weather, and other classroom topics for the 1st grade class. The librarymedia specialist helps students develop interactive multimedia projects for their classes and the community. One such project takes citizens on an adventure tour of Winnipeg.

The most probing questions come from the learners, who are curious about a variety of issues and intent on communicating what they discover.

Contact: Sun Valley Elementary School, 125 Sun Valley Dr., Winnipeg, Manitoba R2G 2W4, Canada; (204) 663-7664.

Self-initiated learning. When students initiate their own learning, they participate in productive questioning, probing for information they can use rather than waiting for the next question on a test or from a teacher. Information resources are central, not peripheral, in day-to-day learning activities. Students gather their own data to learn about topics, using a variety of sources and practicing effective research techniques. They are able to examine the large quantity of information they have gathered, synthesize it, and reduce it to usable quantities for their purposes. They can analyze and interpret information in the context of the problems or questions they have identified, and they can evaluate not only the quality of the information they've gathered but also the processes they've used to gather it.

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The most important role for information technology at Taylorsville Elementary School in Taylorsville, Indiana, is to support a commitment to self-paced, individualized learning. Students participate in a program that emphasizes high expectations in core subjects and allows them to work at their own pace. Teachers use instructional strategies like multiage, multiyear groupings and team-based project work. Teachers facilitate, rather than direct, student learning, and they are comfortable using a variety of information technologies. Two days each school year are devoted to ongoing technology training, and a technology coordinator and three part-time aides assist teachers with their technology-related problem solving.

Contact: Taylorsville Elementary School, 9711 Walnut St., Taylorsville, IN 47280; (812) 526-5448.

A changing role for teachers. To develop self-initiated learners in the Information Age school, the teacher's role must evolve away from dispenser of prefabricated facts to coach and guide. In this continuously changing role, teachers leave fact-finding to the computer, spending their time doing what they were meant to do as content experts: arousing curiosity, asking the right questions at the right time, and stimulating debate and serious discussion around engaging topics. In fact, every adult in the school community communicates the power of knowledge by modeling a love of learning. Preservice and inservice programs require the use of information resources and technologies as an integrated part of teachers' certification and recertification. Teachers create a community among themselves in which they are willing to plan together, share successes, resolve challenges, and model strategies for one another.

Professional development in information technologies is available daily at Adlai Stevenson High School in Lincolnshire, Illinois, in a specialized lab for teachers staffed by a full-time trainer. Proficiency with technology resources is a hiring requirement for teachers. All teaching staff have a three-year period to demonstrate proficiency with voice, data, and video technologies. The rigor of staff training reflects the school's commitment to providing students with an environment that promotes lifelong learning, provides opportunities to access global information and create knowledge, encourages participation from the community, and develops the skills of collaborative problem solving. Teachers and students use information technologies constantly for instruction, assessment, exploration, management, and the school's day-to-day operation.

Contact: Adlai Stevenson High School, One Stevenson Dr.,

Lincolnshire, IL 60069; (847) 634-4000. Internet: http://www.district125.k12.il.us.

Media and technology specialists as central participants. Media and technology specialists are critical in the Information Age school, and their role is twofold. Working with students, they are project facilitators. They can ask the initial questions that help students develop a focus for inquiry. They are thoroughly familiar with the school's and district's information resources and can direct students to multidisciplinary materials suitable for their investigations. With their technology skills, they can expose students to resources in a variety of media as well. They can assist students in their efforts to develop technology-enhanced products and presentations.

Working with teachers, they are instructional designers—partners in curriculum development and unit planning. Their expertise with information resources can inform teachers' exploration of curriculum topics and assist them in locating the materials they need. And, because ongoing professional development is an integral part of the work in an Information Age school, media and technology specialists contribute their expertise to the design and delivery of technology-enhanced inservice programs.

Traditionally, students learned information skills in isolation as part of elementary- and middle-level "library skills" development. Technology "literacy" programs took place in computer labs during pull-out programs or in separately scheduled classes. In the Information Age school, such skills are taught on an as-needed basis, and they are integrated throughout the curriculum.

As a result of a districtwide effort to reform curriculum and instruction, the school day at Christopher Columbus Middle School in Union City, New Jersey, is organized into blocks of 90 minutes to two hours. Longer class periods have allowed teachers to create a project-focused, research-based curriculum that integrates the traditional subject areas with access to local and remote information resources through a variety of technologies. In addition to a central computer lab for whole-class instruction and walk-in use, each of the school's 12 classrooms has five computers, a printer, and a video presentation station. Students also have access to multimedia production equipment, computer video editing capabilities, and Internet connectivity from all PCs. Teachers receive three days of paid technology training each year, and a full-time technology coordinator conducts student computer classes, consults with teachers, and handles troubleshooting.

Contact: Christopher Columbus Middle School, 1500 New York Ave., Union City, NJ 07087; (201) 271-2085.

In the Information Age school, information skills are taught on an as-needed basis, and they are integrated throughout the curriculum.

Continuous evaluation. Everyone in the Information Age school recognizes the need for continuous evaluation not limited to scheduled standardized assessments. They engage in a high level of introspection, asking questions about the appropriateness of information resources, the efficiency of information searches, and the quality of information selection and evaluation. They also examine the quality of the products and presentations they use to share the results of their inquiries, as well as the communication process itself.

The Maryland Virtual High School of Science and Mathematics is a collaboration of 15 schools. They use information technologies to focus on computational science studies, accessing the Internet for mentoring, sharing projects, and assessing science resources. Students and teachers search and communicate online through local area networks (LANs) attached to each school's Internet hub. They use various software applications to create computational models of processes such as climate phenomena, animal population changes, and planetary motion. Teachers from the participating schools attend several three-day professional development sessions each year, as well as a five-day workshop at the end of each school year. Project staff are available for schoolwide training and outreach efforts in the various school communities.

Contact: Maryland Virtual High School of Science and Mathematics, 313 Wayne Ave., Silver Spring, MD 20901; (301) 650-6600; Internet: http://www.mbhs.edu.

A changed environment. An Information Age school has a different look and feel than a traditional school. Classroom methods link information retrieval, analysis, and application with strategies such as cooperative learning, guided inquiry, and thematic teaching. Information technologies are easily accessible, not locked away in media closets or labs. Student projects and products proliferate—not just as display items but as resources for other students and information for future investigations. Classrooms and hallways are frequently the scene of discussions and debates about substantive issues—topics important to both the curriculum and to the students investigating them. Most important, the most probing questions come from the learners, who are curious about a variety of issues and intent on communicating what they discover: How do you know that? What evidence do you have for that? Who says? How can we find out?

The curriculum at Patton Junior High school in Fort Leavenworth, Kansas, is driven by students' needs to be productive members of an ever-advancing Information Age. (U.S.D. 207 Technology Initiatives brochure 1996) Instruction reflects the district's efforts to maintain high standards of achievement while encouraging learners to investigate a variety of topics in an exploratory environment. Students use technology tools and develop life skills in a 26-module program that includes topics such as robotics, audio broadcasting, maintaining a healthy heart, and becoming a confident consumer. The media center and classroom computers all provide Internet access. Teachers can use a centralized media management system to remotely schedule videotape, laserdisc, and interactive CD presentations without the need to check out and transport bulky equipment.

Contact: Patton Junior High School, 5 Grant Ave., Fort Leavenworth, KS 66027; (913) 651-7373; Internet: http://www.ftlvn.k12.ks.us.

How to Begin

To transform your school into an Information Age school, begin by using information technologies to encourage experimentation with the school's program. Focus on improving the connections between curriculum content and school process. Lengthen class periods. Consider multiage grouping. Experiment with interdisciplinary, problem-based, or thematic approaches to instruction. Develop individualized instructional plans for every student. Implement ongoing assessment measures that reflect students' continuous learning (portfolios, projects, performances). Encourage community members to regularly contribute their time and expertise throughout the school. Include them as part of decision-making groups for curriculum and technology planning. Provide incentives to teachers and administrators who demonstrate their willingness to try new methods and share what they've learned with their peers. Hire technology support staff with teaching experience to consult with teachers as well as troubleshoot equipment. Pay teachers to participate in professional development activities.

Rather than sitting back (like passive television viewers) marveling at the ever-increasing quantity of information and the rapidity of change, educators must lead students through a careful, cumulative acquisition of information literacy and technology skills. Teams of school professionals can plan integrated activities focusing on important content while encouraging students to practice these skills. Learners should engage from their earliest years in rich, complex, authentic experiences that provide a tension between creativity and utility. These experiences should also offer frequent opportunities for feedback and an environment of trust and open communication. This "orchestrated immersion" (Palmisano et al. 1993) can help ensure that students will leave their school years better prepared to participate actively and flexibly in their communities and the workplace. ■

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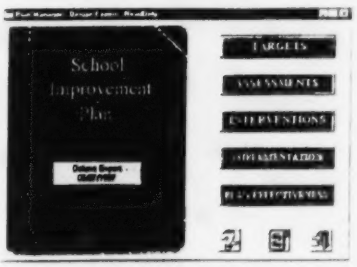
Vicki Hancock is Director of New Ventures at ASCD (e-mail: vhancock@ascd.org).

Finally! Step-by-Step Assistance Designing School Improvement Plans That Meet Current Mandates And Improve Student Performance!



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News

STAGECAST TO BRING APPLE'S COCOA TECHNOLOGY TO MARKET

Startup Licenses Proven Authoring Technology for Kids

Palo Alto, Calif., October 13, 1997 -- Stagecast Software, Inc., a K-12 software company, announced today that it will develop commercial products based on Apple Computer Inc.'s Cocoa technology. Due to recent changes at Apple, the computer company discontinued commercial development of Cocoa. Members of the original Apple development team formed Stagecast to further their dream of creating a product line that takes advantage of the simple graphical programming technology first demonstrated in Cocoa.

David Smith and Allen Cypher, two of Stagecast's founders, were key Cocoa researchers and inventors while at Apple. "We designed Cocoa to be as much fun as a video game, but with challenges that develop thinking and communication skills," said Smith. "Our products will exercise kids' minds, not their thumbs." Cypher alluded to studies indicating that children are spending less time in front of the television and more working with computers. "Our goal is to develop products that replace watching time with thinking time," he said.

"A child having fun with Cocoa is exercising skills that will be useful in school, life, and career," said Larry Tesler, president of Stagecast and former chief scientist of Apple. "Stagecast will develop cross-platform products that strike a balance between the fun factor required by children and the skill development factor desired by parents and teachers."

Mike Lorion, vice president of education, Apple Computer, Inc., said, "Apple has demonstrated Cocoa research prototypes to many educators and the response was enthusiastic. By working with Stagecast to bring Cocoa technology to market we are delivering a great tool for educators and are confident that Stagecast will fully realize the great promise of this

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technology."

Cocoa is an authoring tool and player for desktop and web-based children's software. Apple Computer currently distributes a research prototype of the software tool. Apple's latest design release of Cocoa for the MacOS, version DR2, has been available as a free, unsupported prototype from Apple's web site since July 1997. Version DR2 is now available for free download from Stagecast's web site at http://www.stagecast.com and from Apple's web site [illegible].

Stagecast Software, Inc., headquartered in Palo Alto, California, develops and markets software for K-12 learning activities.

To arrange interviews or for more information, contact Marsha Keeffer or Bruce Roseman at Brough Communications by phone or e-mail.

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Bruce Brough/Marsha Keeffer/Bruce Roseman, Brough Communications, Tel: (408) 430-0100, Fax: (408) 438-0204, Email: bruce@brough.com / marsha@brough.com /

Karl May, Stagecast Software, Inc., Tel: (650) 614-9111 ext 3, Fax: (650) 614-9119, Email: [illegible]

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Last updated: October 13, 1997

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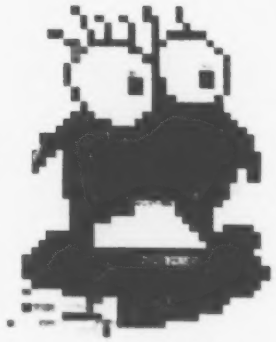

Cocoa

Internet Authoring for Kids

Build your own interactive web pages, video games, or animated stories!

Get Cocoa DR2 right now for free!

Kids' Club

Parents' Place

Teachers' Turn

Important Notice: If you previously downloaded Cocoa DR1, you may have noticed that it expired on July 1, 1997. Please **download and install Cocoa DR2**, which fixes some bugs and extends the expiration date to July 1, 1998. Cocoa DR2 is available free of charge.

To view Cocoa Worlds in your web browser, you need to install the Cocoa Plugin. Cocoa and the Cocoa Plugin are only available for Macintosh currently. Click here for instructions.

After you've installed the Cocoa Plugin, check out some of our cool Sample Worlds and Contest Winners!

Be sure to build some worlds of your own and let us know about them! It's easy...just get a copy of Cocoa, go through the Tutorial or watch a QuickTime Movie to get the knack of it, and let your imagination do the rest!

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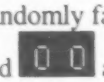
Maintained by the Apple Cocoa DR Team. Last updated Tues, October 28 1997.
E-mail cocoa@apple.com with problems or questions.

Cocoa Samples

Pachinko Math Kit

Pachinko is a Cocoa world in which basic concepts in probability can be explored in a concrete environment. The ball generator produces balls of several different colors which bounce off bumpers randomly falling to the right or the left (with equal probability). The balls are eventually counted  at the bottom of the world.

Click on the ball generator to start or stop the generation of the balls, and click on the reset arrow

to clear all the numbers.

Notice that if you let this world run long enough, the counts at the bottom of the world will be greatest in the very middle (the fourth number from the left) and smallest at both ends. If you graph these numbers, they will form a 'bell curve' shape.

Because you can modify Cocoa worlds, there are a number of experiments that can be done with Pachinko -- typically in these experiments, changes in the patterns of the ball counts at

the bottom of the world are studied as some other characteristic of the world is modified (the probabilities of ball bouncing, the configuration of the bumpers, etc.)

You can download the Pachinko world (63K) to see how it was programmed.

Go on to Roman Numeral Addition...

or back to the Samples Page.

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Maintained by the Apple Cocoa DR Team. Last updated Mon, November 3 1997.
E-mail cocoa@apple.com with problems or questions.

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Agent Developers

Push Technology Providers

Affinicast
Personalized information retrieval service.

Aimsoft
Developer of software and services enabling worldwide, seamless communications over the existing Internet infrastructure.

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Astound
Creators of Astound WebCast, which enables developers to create their own multimedia broadcast channels from existing Web sites.

BackWeb
Subscribe to free channels and receive news, multimedia presentations, fun animations/cartoons, audio announcements, which are downloaded onto your computer's desktop unobtrusively.

Caravelle
Develops advanced network monitoring and Internet/Intranet publishing tools, including a non-proprietary tool that allows businesses to deliver timely content to consumers and end users.

Cognisoft
Developer of server-based intranet push application.

DataChannel
Creators of intranet administration tools that allow IS managers to manage external Web channels and internal information sources on every employee's desktop.

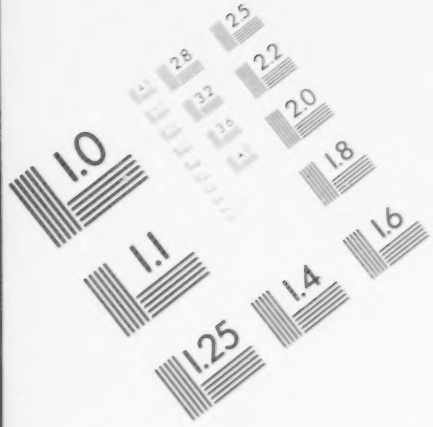
Diffusion
Creators of IntraExpress--a push software product that allows communication with others within defined communities of interest.

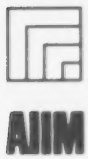
First Floor
Fast and flexible "web-enabling" product for existing client/server solutions, which, using specified agents, allows documents to be interactively monitored and distributed.

inCommon
Integrated accelerated Web browsing, automatic content delivery, and information customization.

Intercast
Intercast product makes it possible for your home PC to receive HTML-formatted Web pages and streaming information along with regular television programming.

Intermind Corporation





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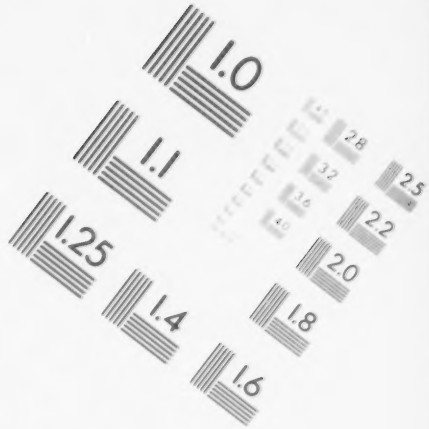

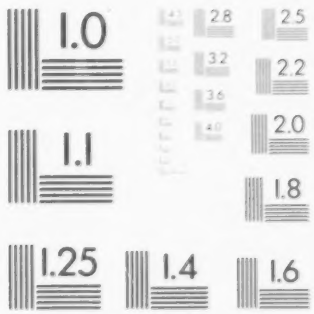

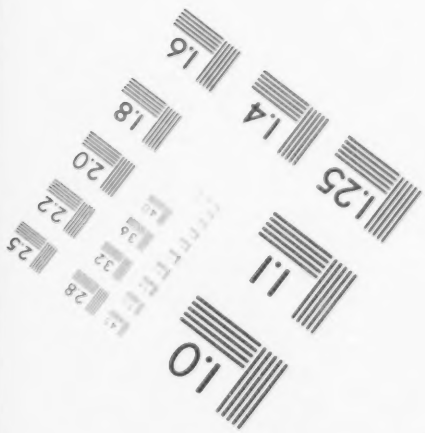

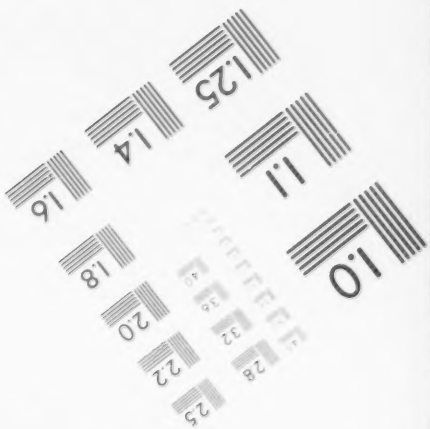

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Developer of communications technologies that enable individuals to have control in creating and maintaining communications relationships over the Web and other electronic networks.

Lanacom
Developer of Headliner, which delivers news and information to Windows 95 and NT desktops.

Marimba
Applications technology company whose products enable developers to create, deploy and maintain robust network managed applications, multimedia experiences, and dynamic information systems within enterprises and across the Internet.

Mercury Mail
Information gathers/customizers who send this requested information to their customers for free.

NetDelivery
Free customizable information service provider.

PointCast
Free, advertiser-supported, customizable news network that broadcasts national and international news, stock information, industry updates, weather, and sports scores.

RevNet
Offers a software program for management and delivery of information over the internet.

Tierra Communications
Offers an information gathering software tool.

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Verity, Inc.
Develops and markets software tools and applications for searching, retrieving, and filtering information across the Internet, enterprise and CD-ROMs.

Wayfarer
Developer of Incisa, an intranet Webcasting solution for business that allows managers to push relevant business information to employee desktops.

Streaming Media Technology Providers

Intel Intercast
Intercast Technology, developed by Intel and Intercast, allows users to receive HTML-formatted Web pages and streaming information along with regular televised programming using the Vertical Blanking Interval (VBI) signal.

Inter VU
A video/multimedia delivery service that delivers a quality video experience through your Web site. The result is faster video that keeps viewers tuned to your site. InterVU works with all popular platforms and all video formats for on-demand video delivery.

Microsoft Netshow
Creator of Enliven software, which streams Macromedia Director files over the Web to viewers using the free viewer plug-in for Netscape Navigator.

Motorola
Developer of TrueStream, which delivers compressed, high-quality audio and video over low bandwidth Internet connections.

Narrative Communications
Creator of Enliven software, which streams Macromedia Director files over the Web to viewers using the free viewer plug-in for Netscape Navigator.

Progressive Networks
Creator of RealAudio, RealVideo, and RealVideo software, which allows user to recieve live and archived audio and video broadcasts in real time.

Macromedia
Creator of Shockwave animation format for the Web and the new Shockwave player, which delivers streaming animation, audio, and multimedia to you with little or no waiting.

Vosaic
Developer of the Java-based Sound Applet and VDP Video Plug-in for streaming audio and video into Java-enhanced browsers.

Vivo Software
Creator VivoActive, a serverless streaming video product.

VXtreme
Developer of Web Theater software suite, anabling users to create and send real-time compressed video across the Internet and corporate intranets.

Xing
Developer of StreamWorks Player (for viewing live and on-demand real-time audio and video) and the XingMPEG Player.

Agent Companies

AgentSoft
Develops and markets sophisticated agent technology, agent development tools, and agent services and applications for the Internet and the corporate Intranet.

Broadvision
Offers software product that enables application developers and business managers to develop efficient Web sites with personalized content.

Firefly
An agent that recommends movies and music based on preferences that are input; also offers live chat rooms and personal home pages.

iCat
Offers iCat Electronic Commerce Suite to aid users in creating, managing, and delivering sophisticated Web catalogs.

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Recommends movies and videos (Best Bets) and gives probable ratings on titles that interest you based on movie ratings you provide.

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InterVU Multimedia Manager

Macintosh Power PC - Netscape 2.0 - 4.01* Installation Instructions

*Vivo player incompatible with Netscape Communicator at this time.

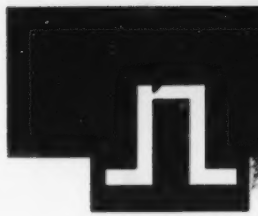
Step 1: Download InterVU's EyeQ installer.
Step 2: Click the Installer Application twice to run it (not the .hqx or .sit files).
Step 3: The default installation asks you to select the Netscape Folder. This is the folder where the Netscape Application is located (Netscape's Parent Folder).
Step 4: The following Netscape Plug-Ins are installed by default into the Plug-Ins folder located in the Netscape folder.

- InterVU Network Smart Seek
- Vivo VivoActive player
- QuickTime Plug-in player
- InterVU MPEG player

The following are installed into the "start up disk" in the InterVU folder. An alias of the folder is placed on the desktop.

- InterVU Fast Track
- InterVU Help and Readme files

Step 5: The Custom install permits you to install individual Netscape plug-ins or the Fast Track and Help/Readme files.
Step 6: Installation trouble shooting suggestions are located inside the Plug-In Help/Readme files folder which is inside the InterVU folder. **Note:** The Mac Threads Manager extension is installed if it is not present.



what is netPodium

see & hear it

compare it

try it

buy it

product support

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in the news

events

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about MetaBridge

site map

WSDMA selects netPodium as finalist for Best Internet Product

November 3, 1997 - netPodium Personal Broadcaster 1.0 from MetaBridge has been chosen as one of three finalists for **Best Internet Product** Industry Achievement Award given by the Washington Software and Digital Media Alliance. The winner will be announced at an awards banquet in Seattle on January 29, 1998.

Version 1.1 Beta software now available to customers

October 21, 1997 - The Beta 1 release of netPodium Personal Broadcaster v1.1 is now available to **current netPodium customers only**. Version 1.1 features the new "AV Frame" which lets you switch between media streams during a broadcast. For example, during a live audio segment you can switch to an audio or video clip embedded in the slide content frame, and then return to your live broadcast when the clip finishes playing. The AV Frame feature also lets a newly defined director role "pass the mic" between multiple remote speakers in different locations. Other v1.1 enhancements in Beta 1 include dynamic Web page preview and persistent polls. Download the beta...

Upcoming Events

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Home

- Attachmate live webcasts
  November 18th and 25th, 1997

CenterPoint Highlights netPodium

CenterPoint, the weekly half hour business and technology television series, will be running a story about netPodium on PBS during coming month. Preview the segment online by accessing the Video library at http://www.cptv.com.

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Internet Tool Review

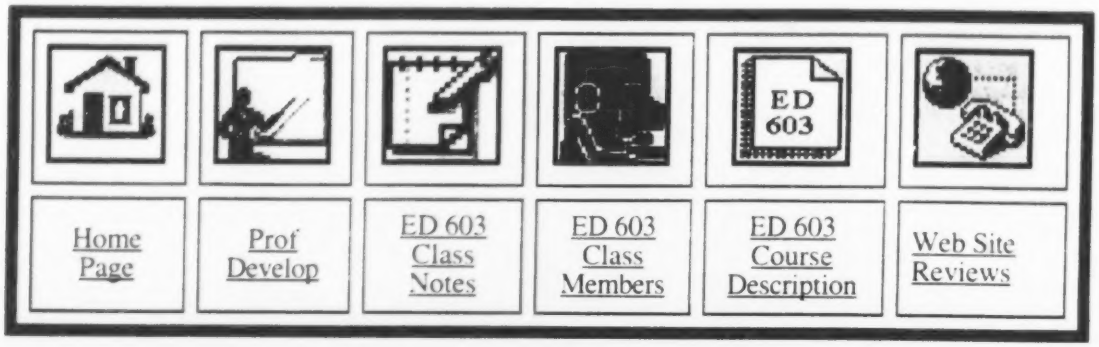
Internet Based Video : CU-SeeME

What is Cu-SeeMe? CU-SeeMe is a useful and inexpensive Internet based desktop videoconferencing system which allows users to communicate each other using audio and video technology. Synchronous communication provides opportunities of immediate feedback and interactive exchanges of ideas . In addition, since users can hear actual voices and watch other peoples gestures, more personal and face-to-face communication is possible. CU-SeeMe software is available from Cornell University at a free of charge and enhanced CU-SeeMe from White is also available. Followings are annotated descriptions of six salient features of Cu-SeeMe.

- Low cost -- Whereas videoconferencing technology through satellite or telephone communication systems requires expensive equipment, high user fees and a dedicated videoconferencing room, Cu-SeeMe software can be downloaded at no cost from Cornell University. CU-SeeMe does not requires any special equipment for video reception beyond a network connection and grey-scale monitor. Video camera with serial port digitizer for transmitting video is available for under $100 (QuickCam by Connectix).
- Multiplatform -- Cu-SeeMe can be run on the Windows, Windows 95, Macintosh and Power Macintosh.
- Participants -- Up to 8 participant windows can be viewed; but the number of audio and talk window is unlimited.
- Controls and Adjustments
    - Talk window -- Besides audio and video interaction, Cu-SeeMe provides "talk window" as a written communication tool. Using "talk window" one can send private messages to an individual during group videoconference or present a written text for group comment. This is also useful features for whom have low-speed connections.
    - Local window control -- Microphone, video, status bar, and connection information.
    - Audio Window -- Separate window for audio settings and control.
    - Picture Adjust Slidebar -- Brightness and contrast.
    - Transmission Control -- Frame rate in bits per second.
    - Individual microphone icon -- This allows private conversations during a group videoconference.
- Reflector -- Cu-SeeMe supports group conferences or video broadcasts to a large audience as well as one-to-one communication. The Reflector is a server-based application which accepts multiple Cu-SeeMe connections and reflects the video, audio, and additional data to all participants concurrently. The list of Reflectors is available from several sites. Click here.
- Additional Features of Enhanced Cu-SeeME from White Pine
    - Caller ID -- Message alert box for incoming connections.
    - Whiteboard for collaboration during conferences; Whiteboard allows users to work on the same document in the remote locations.
    - Color Support -- 24-bit true color and 4-bit greyscale.
    - Phone Book -- Save, add, edit participant addresses and Reflector sites.
    - Video Compression -- Standard and high resolution settings.

The URL for information regarding CU-SeeMe : http://cu-seeme.cornell.edu

Click here to return to **Internet Tool Review** or follow these links to navigate to any of the pages within the **Technological Capabilities Web Site:**



Welcome to CU-SeeMe Schools

sponsored by **Canon** *Visual Communications*

About CU-SeeMe Schools

Introduction

CU-SeeMe in Education

Purpose of this Site

Directory of Schools

List Your School

Reflector Calendar

Special Events

Mailing Lists

CU-HOWTO

CU-SEEME-SCHOOLS

Message Archives

Useful Equipment

Canon

●Digital Vision

Enhanced CU-SeeMe

★ Spotlight!

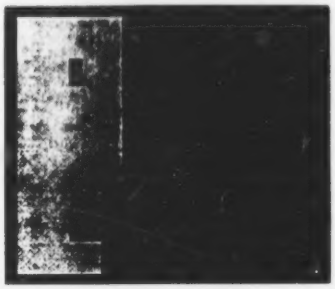
April 24, 1997 Take Your Daughters to Work!

Exclusive! Tim Flannery, Pardres Coach & Musician

Special Offer From Canon!

New Hope-Solebury School District & Canon

CU-SeeMe



Desktop Videoconferencing
from Cornell University

NEW CU-SeeMe: The Authorized Guide!

Download Software

●Cornell University

●White Pine

Resources

●Michael Sattler's CU Site

●CU-SeeMe Event Guide

●Leonard's CAM WORLD

●Live Camera's on the Net

More Information

Introduction

cu-seeme-schools@gsn.org

This list will put you in touch with other K12 schools AROUND THE WORLD who have the capability to do CU-SeeMe video conferencing over the Internet. The list will be used to announce upcoming special events and opportunities for schools to participate in live videoconferences with schools, scientists, authors, government, business, and community leaders.

"Live" interactive video requires the availability of a real-time community focused on accomplishing a task. A video conference is very much like a meeting that is more effective when there is a moderator and an agenda. Holding a "meeting" in cyberspace introduces the additional challenge of different times zones and school schedules.

The Global SchoolNet Foundation (GSN) has been designing collaborative projects incorporating Cornell's CU-SeeMe desktop video-conferencing in the classroom with students since 1992!

CU-SeeMe in Education

Our teachers believe live interactive video conferencing is a VERY valuable instructional tool. Our K12 students have interacted with famous politicians, CEOs, scientists, authors, and other leaders around the world.

Cisco Systems has worked closely with GSN to promote the benefits classroom video-conferenecing in the Global Schoolhouse. Student Ambassadors have joined Cisco's CEO, John Morgridge, in many powerful demonstrations.

On August 24, 1995, CU-SeeMe made its debut on CBS as Dick Cogger and Forrest Milkowski took the UTTM television audience on a CU-See Me tour, stopping to talk to people in the San Francisco area , the Global Schoolhouse, and peeking in at the CU-See Me reflector site at Cornell, where a normal nightly CU-SeeMe party was in progress.

To read about how some students are taking advantage of this exciting and innovative technology, please read Scientist on Tap: Video-Conferencing Over the Internet.

We are currently engineering a pilot project with ABC World News Now in which students are the news correspondents.

Another exciting pilot project is underway with NOAA Scientists.

Before you begin videoconferencing, you must read:

- **Elements of an Effective CU-SeeMe Video Conference**
- **CU on the Net!**

Purpose of this List

List members are encouraged to use this list to:

- announce events that other K12 schools are invited to participate in
- to share lesson plans and implementation strategies for utilizing live inter-active video to enhance the learning environment
- to explore the use of CU-SeeMe to facilitate long distance learning
- identify an audience to view and critique your presentations
- to DISCOVER and DOCUMENT what works and what does not work!

Send Questions to:

cu-help@gsn.org

Global SchoolNet Foundation - *Linking Kids Around the World!*
Copyright © GSN - All Rights Reserved Last Update/16-April-97 -- Comments & Questions

Learning Through Collaborative Visualization (CoVis)

Traditionally, K-12 science education has consisted of the teaching of well-established facts. This approach bears little or no resemblance to the question-centered, collaborative practice of real scientists. Through the use of advanced technologies, the CoVis Project is attempting to transform science learning to better resemble the authentic practice of science.

The CoVis Project is comprised of a team of collaborating researchers in the Learning Sciences at Northwestern University in Chicago, the Department of Atmospheric Sciences at the University of Illinois in Urbana-Champaign, the Exploratorium in San Francisco, and Bellcore in New Jersey.

The CoVis Project will explore issues of scaling, diversity, and sustainability as they relate to the use of networking technologies to enable high school students to work in collaboration with remote students, teachers, and scientists. An important outcome of this work will be the construction of distributed electronic communities dedicated to science learning.

Participating students study atmospheric and environmental sciences through inquiry-based activities. Using state of the art scientific visualization software, specially modified to be appropriate to a learning environment, students have access to the same research tools and data sets used by leading-edge scientists in the field.

The CoVis Project provides students with a range of collaboration and communication tools. These include: desktop video teleconferencing; shared software environments for remote, real-time collaboration; access to the resources of the Internet; a multimedia scientist's "notebook"; and scientific visualization software. In addition to deploying new technology, we work closely with teachers at participating schools to develop new curricula and new pedagogical approaches that take advantage of project-enhanced science learning. "Collaborative Visualization" thus refers to development of scientific understanding which is mediated by scientific visualization tools in a collaborative context. The CoVis Project seeks to understand how science education could take broad advantage of these capabilities, providing motivating experiences for students and teachers with contemporary science tools and topics.

The next decade will bring widespread, networked multimedia interpersonal computing. The CoVis Project is a blueprint to inform educators, researchers, and policy makers on the effective and sustainable use of interpersonal, collaborative media in science education.

Click here to read a summary of the CoVis NIE Proposal

A Two-Page Overview Document of the CoVis Project is available (this is a postscript document - click here for a utility to print postscript from Macintosh computers).

WHAT IS COVIS? | GEOSCIENCES HOME | COVIS WELCOME PAGE

The CoVis Software Setup Guide

The software by the CoVis Community

The CoVis Project has assembled a broad range of software to support collaboration, scientific inquiry, and communication over the Internet. Much of this software needs to be installed and set up on computers at your site. This guide is intended to help you set up the CoVis software on your computers. Some of the software described here is produced and updated by CoVis project personnel, some of the software is publicly available over the Internet, and some of the software is commercial (i.e., you'll need to pay money for it). This listing is *not* exhaustive, and there are lots of other pieces of software that people find useful (like word processors, spreadsheets, charting and graphic programs, statistics programs, etc.).

Software produced by the CoVis project

- The Collaboratory Notebook
- The Weather Graphics Tool (a plug-in for Aldus SuperPaint)
- WorldWatcher
- You can use many CoVis tools directly over the web.
  - The Weather Visualizer
  - The Greenhouse Effect Visualizer
  - The Mentor Database

Additional software available for free on the Internet

- *Communications*
  - Eudora (for electronic mail)
  - NewsWatcher (for Usenet news)
  - Netscape (for world-wide web and gopher browsing)
  - Fetch (for retrieving files from the Internet via FTP)
  - CU-SeeMe (free videoconferencing software)

- *Helpers*
  - StuffIt Expander (for converting items downloaded from the Internet)
  - JPEGView (a tool for viewing images, including JPEG & GIF)
  - SoundMachine (a tool for playing sounds from the Internet)

- *Graphics*
  - GraphicConverter (for converting graphics from .pict to .gif and back)

- *Administrator Utilities*
  - FrontDoor (for administering accounts on the BBN Internet Server)

Additional commercial software used in CoVis

- *Communication Tools*
  - Timbuktu Pro, by Farallon

Click here to return to Tech Support Central

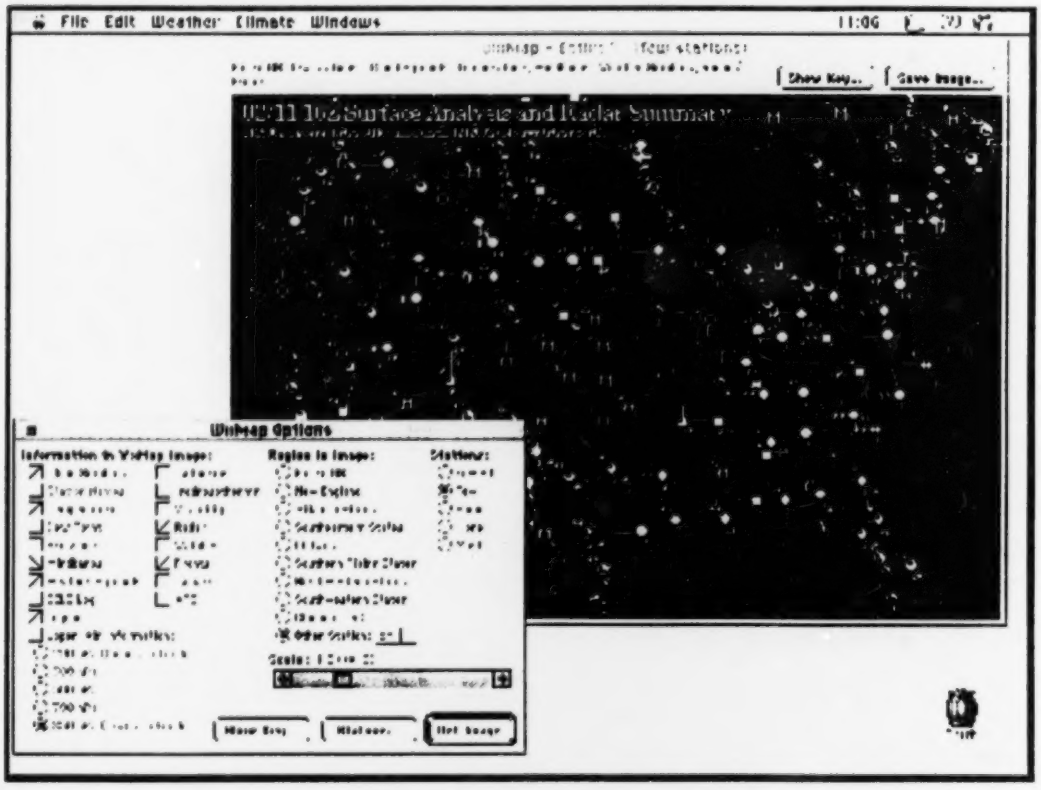
Click here to return to CoVis Home Page

The Weather Visualizer

The Weather Visualizer provides a graphical front-end to real-time weather data. This tool supports activities such as prediction and explanation, as well as project activities in a wide range of meteorological topics.

Customized Weather Maps (WxMaps):

A point-and-click pallette allows students to select the variables they want drawn on a customized weather map. The images are generated on demand by a Unix application called WxMap, and then converted for display on the student's computer. As with all the images shown on this page, these maps may be saved into the student's notebook as part of ongoing research.



Current Satellite Images:

The Weather Visualizer also provides a facility for generating current satellite images, both visible and infrared. These images come from the GOES-7 weather satellite and are provided by the University of Illinois at Urbana-Champaign.

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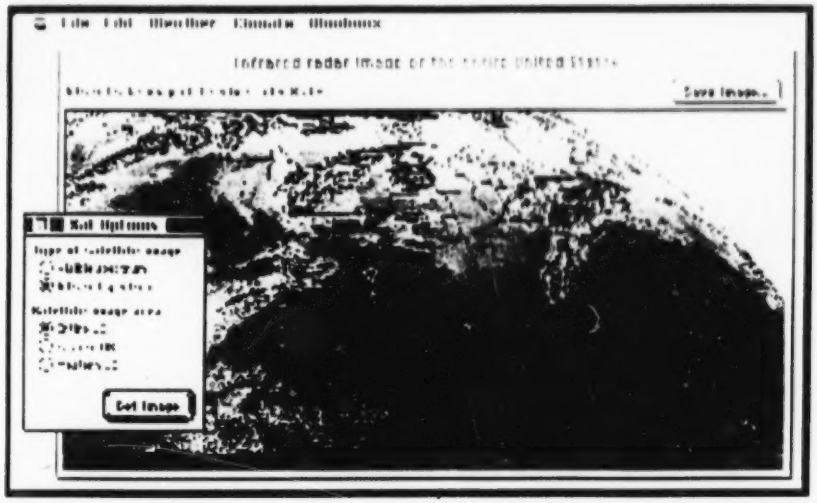
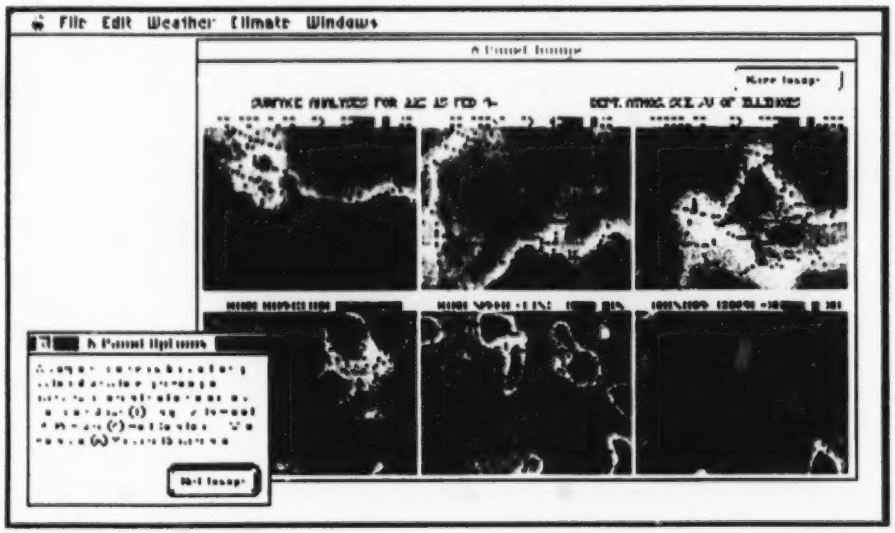


Six Panel Images:

These images, designed at the University of Illinois, provide an overview of six different weather variables across the United States. These variables are: temperature, wind speed, wind direction, relative humidity, pressure, and moisure convergence.



Reports and Forecasts:

Using the Reports and Forecasts tools, students can get current weather reports as well as local and state forecasts for any weather station on the North American continent. There's also support for encoding and decoding station names.

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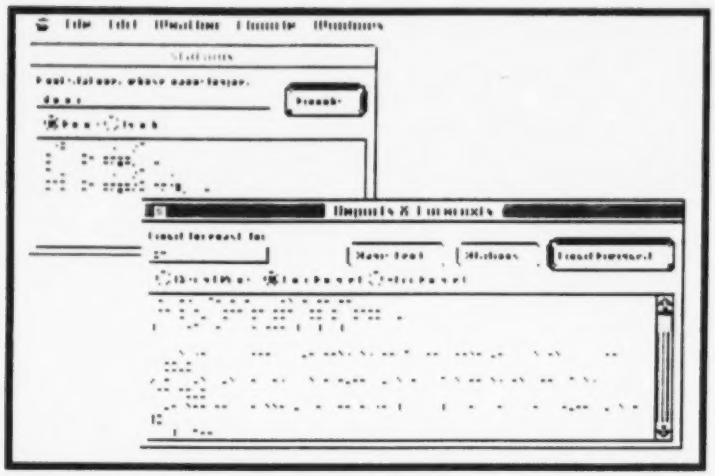

For a detailed discussion of the pedagogical settings these tools were designed for, see: Fishman, B. & D'Amico, L. (1994). *Which way will the wind blow? Networked computer tools for studying the weather.* Paper presented at the meeting of ED-MEDIA 94, Vancouver, B.C.

For readers who are generally interested in weather imagery and data, the University of Illinois at Urbana-Champaign operates two servers. The UIUC gopher server and WWW server provide a broad range of current atmospheric images and information. If you'd like more information on the Weather Visualizer or its components, please contact Barry Fishman, email: bfishman@ils.nwu.edu

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WHAT IS COVIS? | OVERVIEW OF COVIS SOFTWARE

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The Collaboratory Notebook

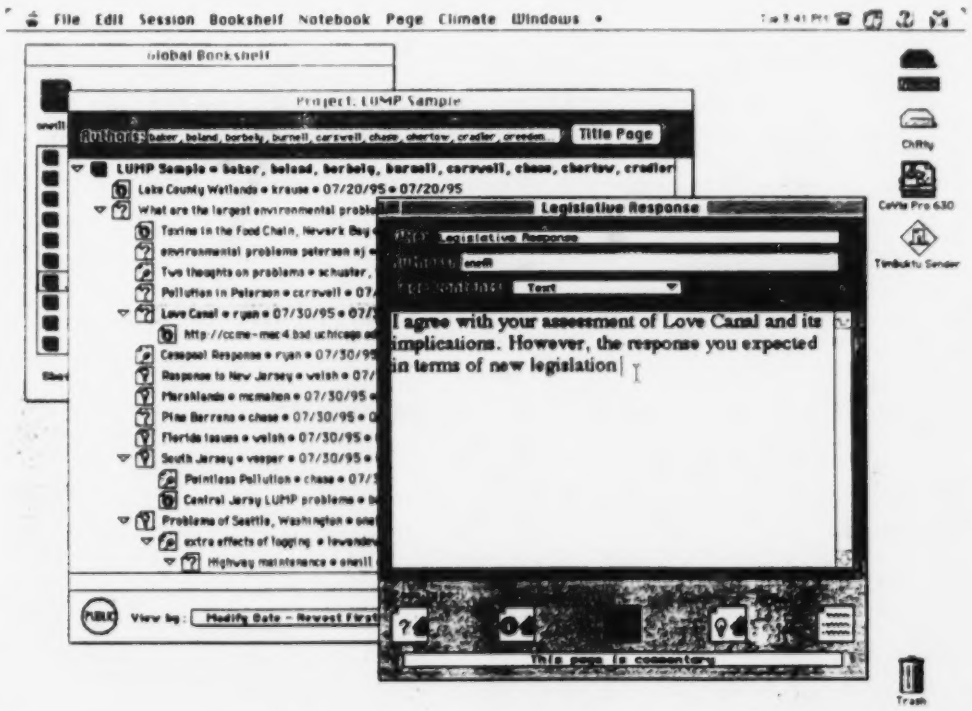
An Overview

The Collaboratory Notebook is a networked, multimedia tool that supports group work in project science learning. It provides a single, pedagogically-motivated medium in which students, teachers and research scientists can collaborate on scientific inquiry across boundaries of time and space.

The software is based on the metaphor of the scientist`s laboratory notebook, with a bookshelf, notebooks and pages being the primary interface elements. It extends this metaphor with facilities for collaborators anywhere on the Internet to share and co-author inquiry.

Flexible facilities for sharing inquiry

Project-centered dialogue takes place in individual notebooks, which can have varying degrees of privacy or publicity. These range from single-author journals to topical discussions which anyone using the software can contribute to. Each notebook provides a medium for local and remote collaborators to express their ideas, record project-related efforts, and respond to one another with questions, commentary, conjectures, and plans for future investigation.


File Edit Session Bookshelf Notebook Page Climate Windows
Global Bookshelf
Project: LUMP Sample
Authors:
Title Page
Legislative Response
I agree with your assessment of Love Canal and its implications. However, the response you expected in terms of new legislation
This page is commentary
Trash

A scaffolding structure for learning and assessment

As well as storing the products of a students` investigation (such as data visualizations), pages in a collaboratory notebook have a rich relational structure that reflects the process of the investigation that they document. This relational structure has been designed to scaffold the process of scientific research for those

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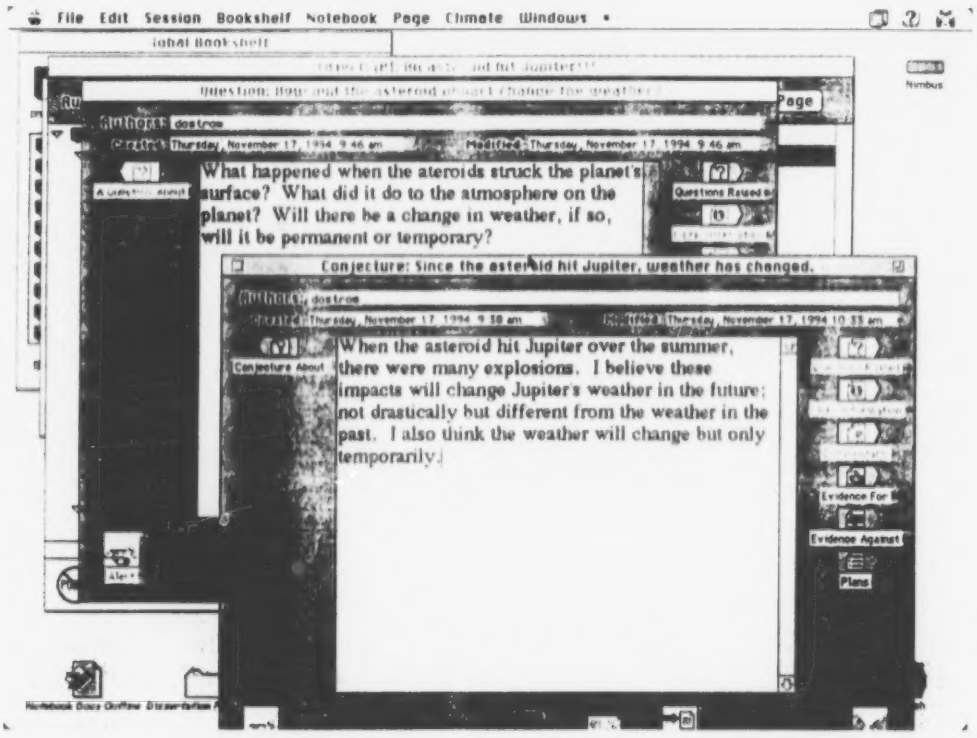
who have never performed independent inquiry before, and provide teachers with an additional means to conduct non-intrusive, just-in-time assessment of students' work.


File Edit Session Bookshelf Notebook Page Climate Windows
Page
What happened when the ateroids struck the planet's surface? What did it do to the atmosphere on the planet? Will there be a change in weather, if so, will it be permanent or temporary?
Conjecture: Since the asteroid hit Jupiter, weather has changed.
When the asteroid hit Jupiter over the summer, there were many explosions. I believe these impacts will change Jupiter's weather in the future; not drastically but different from the weather in the past. I also think the weather will change but only temporarily.
Evidence Against
Plans

Each page that is written in a collaboratory notebook is classified using a fixed set of inquiry-focused categories which give the contents of a notebook their internal structure. By creating a number of pages, each containing only a small amount of text, a student can create a large, complex investigation in a stepwise fashion that makes the relations of the individual parts explicit. The collaborative nature of the work supported by the notebook also means that through responding to each research question, plan, or conjecture with their own thoughts, collaborators may encourage one another to clarify or extend their contributions to the group effort.

Publications about the Collaboratory Notebook and its Use:

O'Neill, D. K., Edelson, D. C., Gomez, L. M., & D'Amico, L. (1995). Learning to Weave Collaborative Hypermedia into Classroom Practice. In J.L. Schnase & E. L. Cunnius (Eds.) Proceedings of CSCL '95: The First International Conference on Computer Support for Collaborative Learning, October 17-20, 1995, Bloomington, Indiana. Hillsdale, NJ: Erlbaum.

Edelson, D. C., O'Neill, D. K., Gomez, L. M., & D'Amico, L. (1995). A Design for Effective Support of Inquiry and Collaboration. In J.L. Schnase & E. L. Cunnius (Eds.) Proceedings of CSCL '95: The First International Conference on Computer Support for Collaborative Learning, October 17-20, 1995, Bloomington, Indiana. Hillsdale, NJ: Erlbaum.

Edelson, D.C., & O'Neill, D.K. (1994). The CoVis Collaboratory Notebook: Supporting collaborative scientific inquiry. In *Proceedings of the 1994 National Educational Computing Conference.* Available upon request from (d-edelson@nwu.edu)

Edelson, D.C. & O'Neill, D.K. (1994, April). *The CoVis Collaboratory Notebook: Computer support for scientific inquiry.* Paper presented at the meeting of the American Educational Research Association, New Orleans, LA. Available upon request from (d-edelson@nwu.edu)

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O'Neill, D.K., Gomez, L.M. and Edelson, D.C. (1994). Collaborative Hypermedia for the Classroom and Beyond: A Year's Experiences with the Collaboratory Notebook. In Haake, J.M. (ed.), Proceedings of the CSCW '94 Workshop on Collaborative Hypermedia Systems, Oct. 22, 1994, Chapel Hill, North Carolina.

O'Neill, D.K. and Gomez, L.M. (1994). The Collaboratory Notebook: a Networked Knowledge-Building Environment for Project Learning. In Proceedings of Ed-Media '94: World Conference on Educational Multimedia and Hypermedia, June 25-30, 1994, Vancouver, BC, Canada.

Software Availability

We have recieved many messages from people wanting to know where they can download a copy of the Collaboratory Notebook, or how they can purchase a license for it. Unfortunately, this software is not yet at the "product" stage. We consider it a robust prototype, but it is undergoing constant refinement. We consider this refinement a research effort, and from time to time we allow others to use the Collaboratory Notebook, when the use that they have in mind is interesting to us and meets our research aims. If you have an interesting use in mind, you might want to contact us.

Contact Danny Edelson at (d-edelson@nwu.edu) or Kevin O'Neill (oneill@covis.nwu.edu) for more information about the Collaboratory Notebook.

WHAT IS COVIS? | OVERVIEW OF COVIS SOFTWARE

What is an intelligent agent?

Intelligent - an agent that will learn from you and go out onto the web and hunt and retrieve information for you.

Personalized - agents can be trained to adopt to their users likes and dislikes, tastes and preferences.

Flexible - agents have initiative and can offer suggestions.

Autonomous - agents are capable of sensing and responding to their immediate environment and of making judgments.

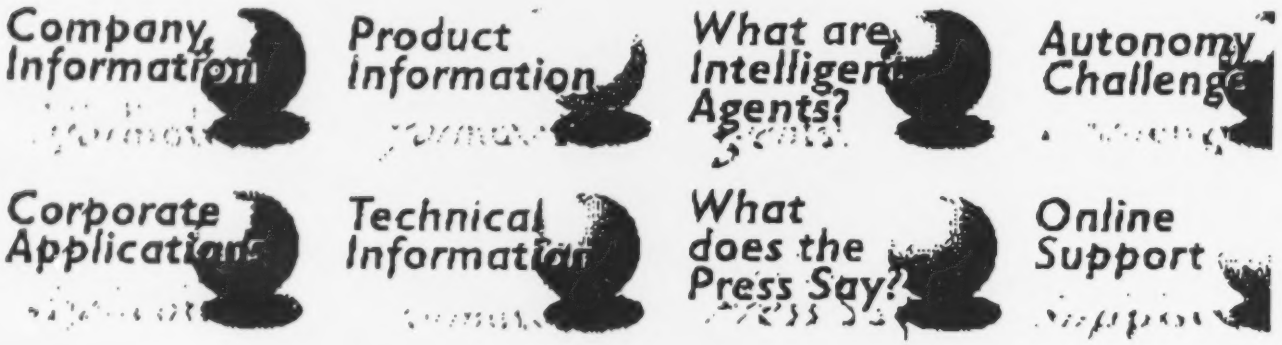
Specialized - agents that are trained in their specialized fields, giving you the support of loyal professionals. Autonomy offers you a number of agent applications.

The original notion of an autonomous agent was an entity similar to a sophisticated "spider" which would roam the various domains of the internet and act on behalf of its "master". The idea was to provide users of the internet with a personal information "gopher", capable of hunting for and retrieving information requested by the individual.

A great deal has been written in the press about intelligent agents, AI (Artificial Intelligence) based programs that reach into cyberspace to search, and even act, on their client's behalf, understanding their clients tastes and needs. Suddenly bandwidth congestion becomes a thing of the past as agents roam the networks of the world while their users perform more urgent tasks or even go off-line.

A future is envisioned of agents as the interface that we use in our dealings with computers and the Internet. Many such claims reside firmly in the land of science fiction: agents that talk to you in the middle of a negotiation or that take your credit card details out to buy the best value used Ferrari.

Many companies have used the expression *Intelligent Agent* as a way of capitalizing on the great surge of expectation that exists in the internet community for its *Holy Grail*. Their products have, without exception, fallen short of the mark. October 1996 saw the launch of Autonomy, a suite of Intelligent Agent software from Autonomy, the first truly intelligent agent software to become available.



Agent-Oriented Programming

Applying Software Agents to Software Communication, Integration, and HCI

The Agent-oriented Programming project aims to develop a new programming paradigm that exploits the computational advantages of attributing mental states to machines, employs ideas from speech act theory, and relies on computational versions of social laws.

Agent-oriented Programming is a programming paradigm in which computer agents are assumed to have a formal version of mental states---states which dictate agents' actions and which are affected by messages they receive. Agent-oriented programming provides a new approach to programming distributed systems, emphasizing explicit representation of time, beliefs, and commitments, including speech-act-like communicative commands. Our work includes the theoretical investigation of agents with mental states, interpreter design and implementation, and applications such as information retrieval, personal software assistants, and robotics. We are also investigating the compilation of such a language into a neutral, agentless process language.

These studies raise a number of logical issues, particularly in defining mental states as such, as well as algorithmic issues involved in defining the interpreter and compiler.

- In Lamarre and Shoham 1994, we present a system to capture the relationship between knowledge and belief which also sheds light on each of them in isolation. In the case of knowledge, we reject the property of negative introspection. In the case of belief, we propose a distinction between belief (whose defeasibility is recognized by the agent) and certianty (whose defeasibility is not). The relationship among the three notions---belief, certainty, knowledge---goes beyond mere hierarchy. In particular, knowledge has the flavor of belief that is stable under incorporation of correct facts. We explore these three notions through a model theory which is based on notions of the agent's subconscious biases and conscious preferences (or plausibility measure). We provide a sound and complete axiomatic system and point to some of its illuminating properties. We compare our construction to previous ones in AI and philosophy, and in particular point to connections with recent work in AI based on conditionals.
- Belief *revision* and belief *update* are normally considered as distinct types of belief modification. In Del Val and Shoham 1994b, we show that both can be captured within a unified formalism in which revsion is encoded as *update of the mental state* . We show that the framework for belief update presented in Del Val and Shoham 1993 and 1994a can also be used to capture revision by extending the underlying language to include explicit representations of the agents beliefs. This framework allows for the definition of a wide variety of revision operators, including in particular all of the AGM operators, for which we provide a representation theorem.
- Inspired by successes of the distributed computing community in applying logics of knowledge and time to reasoning about distributed protocols, we aim for a similarly powerful and high-level abstraction when reasoning about control problems involving uncertainty. In Brafman, Latombe, and Shoham 1993 we concentrate on robot motion planning, with uncertainty in both control and sensing.

This problem has been well studied in the robotics community. Our contributions include the following:

1. We define a new and natural problem in this domain: obtaining a sound and complete termination condition, given initial and goal locations.
2. We consider a specific class of simple motion plans in R^n from the literature, and provide necessary and sufficient conditions for the existence of sound and complete termination conditions for plans in that class.
3. We define a high-level language, a logic of time and knowledge, to reason about motion plans in the presence of uncertainty, and use them to provide general conditions for the existence of sound and complete termination conditions for a broader class of motion plans.

- *Co-learning* can be thought of as a multi-agent generalization of reinforcement learning. In a co-learning framework the environment of each agent consists at least in part of other agents, all engaged in a similar learning process. The actions of each agent thus affect not only its reward and information state but also the future rewards and information states of other agents. The result is a highly nonlinear dynamic system. In Schaerf, Shoham, and Tennenholtz 1994, we study the process of co-learning in the context of the concrete problem of load balancing in a distributed system without use of either central coordination or explicit communication. We define a precise framework in which to study load balancing, important features of which are its stochastic nature and the purely local information available to individual agents. We define a parametric family of adaptive local resource-selection rules, and for comparison purposes, define a number of nonadaptive ones. We present results obtained from substantial computer simulations. Our results show that the adaptive rules easily outperform the nonadaptive ones in dynamic ebvironments and fare only marginally worse in static environments. We show results on the interplay between basic adaptive behavior parameters and how they affect system efficiency.
- We are exploring the possible utility of social laws in a computational environment---laws which guarantee successful coexistence of multiple programs and programmers. In Shoham and Tennenholtz 1994 we explore the off-line design of social laws. We consider the use of social laws in a domain of mobile robots, and prove analytic results about the usefulness of this approach in that setting. Second, we present a general model of social law in a computational system, and investigate some of its properties. This includes a definition of the basic computational problem involved with the design of multi-agent systems, and an investigation of the automatic synthesis of useful social laws in the framework of a model which refers specifically to social laws.

The background for these and other studies is provided by basic modal logic and its application in distributed computation, basic data structures, algorithms, and complexity. We also draw on connections with object-oriented programming, speech-act theory, distributed computation, temporal logic, intensional logics, belief revision, nonmonotonic logics, and literature in economics on social structures.

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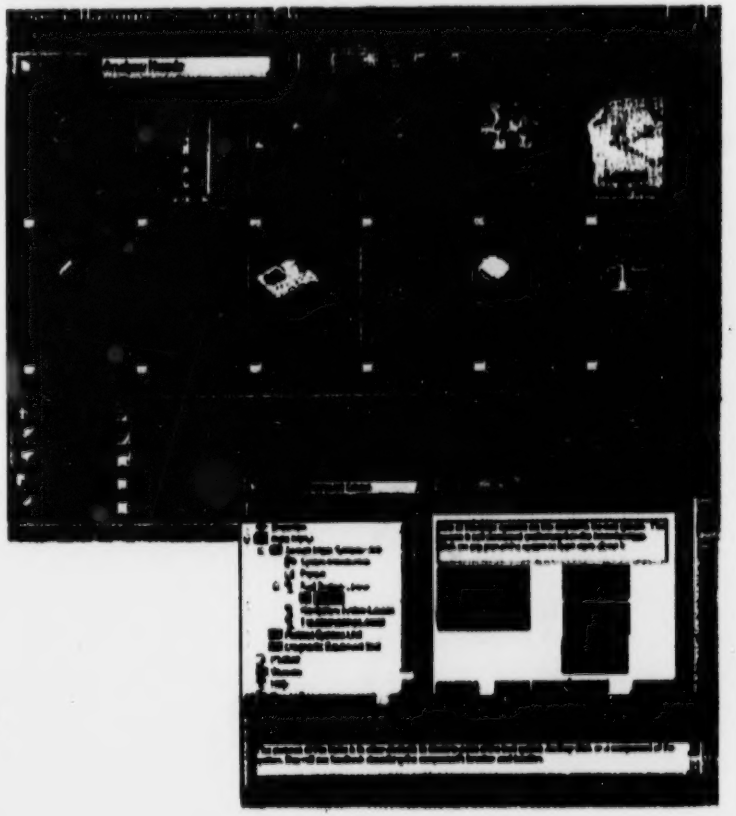

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Process Acceleration:

- Integrates data and displays it in a visual course map for easy access
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- Twenty-five pre-built data collection forms
- Wizards to prompt designers through the development of key reports and other materials
- Stores all design files for easy access by any member of the development team.

Data Organization:

- Automatically generates key documents, such as needs analysis, audience profiles, course maps, design strategies, script-storyboards, and more
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- Creates a central media log of video, graphics, audio, and animation elements, all with on-line sorting capability
- Enhances group productivity by making relevant data easily accessible to team members

On-line Instructional Expertise:

- Step by step guidance through the instructional design process (ISD model)
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Designer's Edge is produced by Allen Communication, a Times Mirror Company. They can be contacted on the Web at http://www.allencomm.com/

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